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JULY 1960

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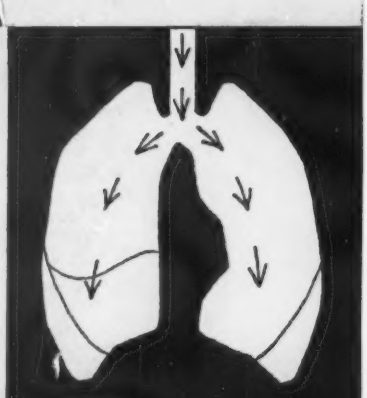

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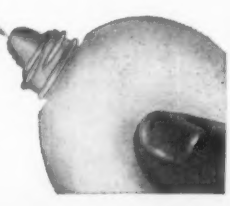

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INDUSTRIAL MEDICINE and SURGERY

ESTABLISHED 1932

The International Journal of Medicine in Industry

JULY, 1960
VOLUME XXIX
NUMBER 7

CONTENTS

Retirement from the Viewpoint of a Medical Director ... 309
William P. Shepard, M.D.

Hazards of Microwave Radiations, A Review 315
Kuo-Chiew Quan, B.E.E., M.D.

Drug Evaluation in Industrial Medicine — Purposes and Procedures 319
Bernard Behrend, M.D., Esther Jaeger, R.N.

The Use of Gammacorten (Dexamethasone) in Acute Periarticular Rheumatism 324
Herman H. Tillis, M.D.

Theories of the Causes of Silicosis — Part I 326
G. W. H. Schepers, M.D., D.Sc.

Trauma and Vascular Diseases Arising from Cold Injury .. 334
Harry E. Tebrock, M.D., Martin M. Fisher, M.D.

Goniometric Study of the Human Foot in Standing and Walking 338
Peter V. Karpovich, M.D., Leighton B. Wilklow, M.D.

Abstracts, Letters, Books 348

Editorials: Incident at Chicago 351

Dexterity 352

Personal News & Notes 4, 6, 8

Comment and Opinion 27

Index of Advertisers 36

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PERSONAL NEWS AND NOTES

"Occupational Medicine," a full-time course for physicians, will be given for eight weeks from September 12 through November 4, 1960 by the New York University Post-Graduate Medical School.

The course content covers the following areas: preventive medicine, including epidemiology and biostatistics, administrative medicine, occupational diseases, and industrial hygiene. It is aimed at meeting the need for specialized training in industrial medicine. Didactic instruction will be supplemented with field trips to industrial plants, governmental agencies concerned with industrial health and to union health centers. Opportunity will be given to attend medical, surgical, and clinical-pathological conferences held in the New York University-Bellevue Medical Center.

For further information write: Office of the Associate Dean, NYU Post-Graduate Medical School, 550 First Avenue, New York 16, N. Y.

The Occupational Health Information Exchange has been established as a central facility for the collection and exchange of information on all aspects of occupational health. Objectives of this activity are:

The collection and exchange of information on the health problems of the worker and his environment and their control with particular emphasis on the problems arising from new materials, new operations and new processes.

The collection and collation of unpublished, uncoordinated, unconfirmed or fragmentary data from industrial experiences, research observations and other sources. The intent of this work is to bring the benefits of such data to a larger group, to obtain the data on human exposures which cannot be obtained experimentally, and to predict and to evaluate the new occupational diseases.

The observation of trends in industrial and agricultural technology and production. Through data on employment, production and consumption of materials, a measure of the potential prevalence of occupational health problems is possible.

An inventory of the total research and service facilities in the field of occupational health. Such information can be utilized to expedite information services and to minimize duplication of efforts.

The information files will be extensively cross indexed and coordinated with published articles by means of a punch card system. In so far as is possible the Occupational Health Information Exchange will answer requests for information or refer them to personnel of the Occupational Health Program or other qualified sources. Articles and bulletins will be published when information received and available for release justifies it. No regular or periodic schedule of publications is planned.

The success of this Information Exchange will depend upon the cooperation of all persons having interests or responsibilities in occupational health. Information pertinent to this operations objectives will be gratefully received from any source. This is intended to be truly an *exchange* and the value of services will be in direct proportion to the quality and quantity of information supplied to the files. Questions, contributions and cooperation are welcomed.

For information write: Occupational Health Field Headquarters, Bureau of State Services, 1014 Broadway, Cincinnati 2, Ohio.

ARNOLD B. KURLANDER, M.D., has been named the Assistant Surgeon General of the Public Health Service.

In his new post, DR. KURLANDER, formerly Deputy Chief of the Service's Bureau of Medical Services, will be third in command in the Public Health Service. His specific area of responsibility will be to provide immediate staff assistance to the Surgeon General on current program matters, to facilitate communications between the four

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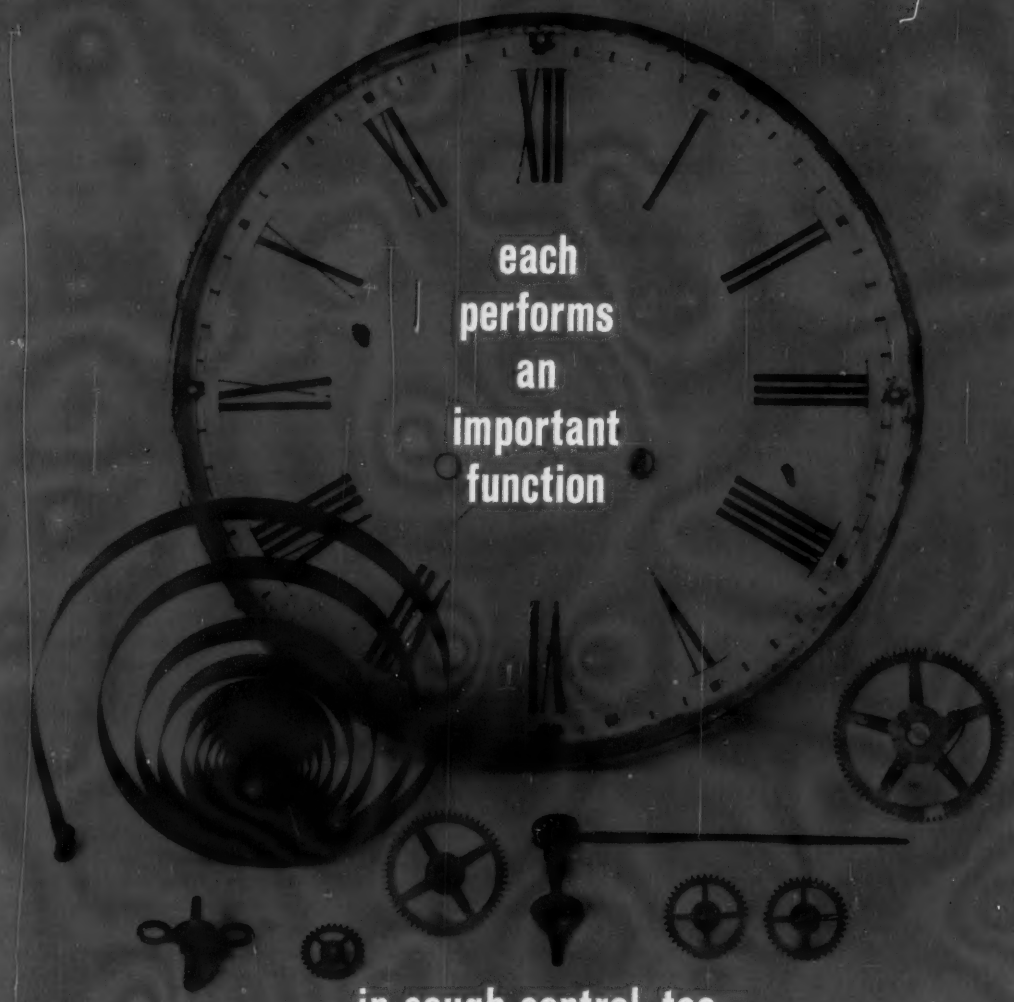

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Bureaus of the Service and the Surgeon General's office, and to expedite the handling of program aspects of operating problems.

DR. KURLANDER, who is a career officer of the Public Health Service, has been a member of the Commissioned Corps since 1940. Following the completion of his internship at the U. S. Public Health Service Hospital in New Orleans, he served as tuberculosis control officer on loan to the State Health Departments of Arizona and Ohio. In 1950, he came to Washington as Chief of the State Aid Branch, Division of Tuberculosis Control, and subsequently was named assistant chief and then chief of the Chronic Disease Program.

He was Assistant Professor of Preventive Medicine at Ohio State University Medical School while stationed in Ohio. During World War II, he served as medical officer of the U. S. Coast Guard Cutter "Comanche."

He is a member of the American Medical Association, a Fellow of the American Public Health Association, a Fellow of the American College of Preventive Medicine, and a diplomate of the American Board of Preventive Medicine and Public Health.

Gallaudet College and the American Speech and Hearing Association have established a National Index on Deafness, Speech and Hearing. This Index will combine the present indexing and abstracting functions of the Central Index of Research on the Deaf at Gallaudet College and the projected indexing and abstracting functions of the American Speech and Hearing Association.

The general policies of the National Index on Deafness, Speech and Hearing will be formulated by a committee composed of representatives of Gallaudet College and representatives of the American Speech and Hearing Association. The Index will be located at Gallaudet College. It will be directed by STEPHEN P. QUIGLEY, Ph.D.

The purpose of the National Index is to index and abstract all professional literature pertaining to deafness, speech and hearing and to make this material readily available to all interested persons. Not only will present and future literature be included but also all of the relevant past literature. The National Index will make the collected material available through a regular, professional publication. It is believed that the National Index will provide a necessary and useful service to all persons concerned with the problems of deafness, speech and hearing.

The National Index on Deafnes, Speech and Hearing is made possible in part by a grant from the Office of Vocational Rehabilitation of the Department of Health, Education and Welfare.

For further information, write: Dr. Stephen P. Quigley, Director, National Index on Deafness, Speech and Hearing, Gallaudet College, Washington 2, D. C.

Pennsylvania Health Department has been approved for a residency in occupational medicine according to CHARLES L. WILBAR, JR., M.D., State Secretary of Health.

Approval was granted by American Medical Association's Review Committee for Preventive Medicine. This committee represents both the American Board of Preventive Medicine and the Council on Medical Education and Hospitals. Last year, the same committee approved Pennsylvania Health Department for a residency in public health.

DR. WILBAR said that the occupational medicine resident will train in the Department's Occupational Health Division, headed by JAN LIEBEN, M.D. Only graduates of accredited medical schools who have completed their internship will be eligible to apply for the one-year residency. Applications are being received by the Health Department, P.O. Box 90, Harrisburg, Pa.

DR. WILBAR defined occupational medicine as that branch of the medical profession which, through cooperation with labor and industry, "protects and promotes the health of the worker and prevents occupational diseases." The Department's Occupational Health Division, in its efforts to protect four million workers, is involved in radiation protection, air pollution control, studies of silicosis and other occupational hazards, medical and nursing consultations and industrial dentistry.

Colby College, in Waterville, Maine, announces its eighth consecutive Institute on Occupational Hearing Loss, August 8-12. The course is designed to train physicians, plant nurses, plant engineers and others in initiating and conducting hearing conservation programs in noisy industries. The course is comprehensive and includes all phases of the problem. The fee of $200 includes tuition, board and room. Requests for further information should be made to WILLIAM A. MACOMBER, Colby College, Waterville, Maine. DR. FREDERICK T. HILL and DR. JOSEPH SATALOFF are directors of the program.

Health Research Foundation of Asheville, North Carolina, founded in 1957 by REUBEN B. ROBERTSON, former President and Chairman of the Board of Champion Paper and Fibre Company, has now been transferred to the University of North Carolina. This transfer was announced by GEN. ROBERT L. EICHELBERGER, Chairman of the Foundation's Board of Trustees. HERMAN A. TYROLER, M.D., the Foundation's Research Director, has been made an associate professor at the university, and JOHN A. CASSELL, M.D., has been made Medical Director of the Foundation.

In announcing the trustees' decision to transfer research activities to Chapel Hill, GEN. EICHELBERGER paid tribute to ROBERTSON and his family for their generosity in establishing the foundation and stated, "This close association with the university will add the professional assistance of the many related university departments and provide data processing equipment and biostatistical assistance that is the key to any modern research effort."

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SIMON MELECK, M.D., has been appointed as full-time Medical Director of the Fafnir Bearing Company, New Britain, Connecticut.

He succeeds BLISS B. CLARK, M.D., former Medical Director, who will continue to serve as Medical Consultant at Fafnir.

DR. MELECK has been engaged in general practice locally since July, 1958, and is on the staff of New Britain General Hospital.

A native of London, England, DR. MELECK was educated at the Raines School, London University, and the London Hospital Medical College. He served his internship at London Hospital and then spent five years in the British Navy including three years in naval hospitals.

Starting in 1946, he held surgical and medical residencies at different hospitals in London until 1950. At that time he moved to Cornwall, England, where he engaged in general practice and was a part-time factory surgeon.

In 1957 DR. MELECK left England for the United States. He spent one year at a state hospital in Virginia before coming to New Britain. In addition to his regular practice, he has been part-time medical officer for the Connecticut Stamping and Bending Co. and for the 63rd Artillery (Nike) Group.

Guide to Records for Health Services in Small Industries recently has been issued by the American Conference of Governmental Industrial Hygienists. The manual, consisting of 32 pages of text and suggested forms, was developed in response to a need for specific guidelines on health records in industry. It is especially designed to assist in developing or improving record systems for employee health services in small industrial or business establishments.

Copies of the Guide are available for $1.00 from the Secretary-Treasurer of the organization, % Occupational Health Field Headquarters, Public Health Service, U. S. Department of Health, Education, and Welfare, 1014 Broadway, Cincinnati 2, Ohio.

College of Medical Evangelists, Los Angeles and Loma Linda, California, will present a series of industrial medicine lectures now in production. The following courses and lecturers so far have been announced: Organized Health Plans by A. B. HALVERSON, M.D., Problem Drinking in Industry by S. CHARLES FRANCO, M.D., Industrial Medicine — An Introductory View, Part I and Part II, by JEAN S. FELTON, M.D., The Worker and His Heart by LEONARD J. GOLDWATER, M.D., Workmen's Compensation by CHRISTOPHER LEGGO, M.D., Noise in Industry (Causes), and Noise in Industry (Prevention of Deafness) by ARAM GLORIG, JR., M.D., Industrial Diseases by R. T. JOHNSON, M.D., Your Patient and Social Security — Practical Aspects of Disability Evaluation by LEMUEL C. McGEE, M.D., and Working with the Industrial Physician by EDWARD P. LUONGO, M.D.

D. JOHN LAUER, M.D., Past President (1959-1960) of Industrial Medical Association, has resigned as Medical Director of Jones-Laughlin Steel Corporation, Pittsburgh, to become Medical Director of International Telephone and Telegraph Company, New York City.

WILSON P. RICHARDS, M.D., has been appointed Group Medical Director for seven Chrysler Corporation plants, it was recently announced by M. W. JOCZ, M.D., Corporate Medical Director.

At the time of the last sessions of The Ramazzini Society two vacancies existed within the traditional total of 31. To make the number complete there were elected to membership Leo Wade, M.D., Medical Director, Esso Standard Oil Company, New York; and William F. Ashe, M.D., Professor of Preventive Medicine and Industrial Health, Ohio State University, Columbus, Ohio.

Died

CARL T. OLSON, M.D., F.A.C.S., 67, Medical Director for Liberty Mutual Insurance Company's Midwest Division for 11 years until his retirement in August, 1957, at St. Petersburg, Florida, April 1.

DR. OLSON was born in Duluth in April, 1893; received his M.D. at Rush Medical College in 1919; interned at St. Luke's Hospital and Cook County Hospital, Chicago, and in 1920 established the general practice which was to engage him until 1943. In that year he became Medical Director for Fansteel Metallurgical Corporation, at North Chicago, Illinois. During his several years at Fansteel he conducted special research on hydrofluoric acid burns, and on tantalum oxide as a wound covering, and wrote a series of articles on tantalum and its place in surgery.

For some time prior to his retirement he was deeply interested in workmen's compensation, and was Chairman of the IMA Committee on that subject. After his retirement he lived in St. Petersburg.

ALBERT STANLEY GRAY, M.D., on April 21, 1960, at the age of 79, after a brief illness. Following six years with the U. S. Public Health Service in the Office of Industrial Hygiene and Sanitation, DR. GRAY became the first Director of the Bureau of Industrial Hygiene of the Connecticut State Department of Health in 1928. He served as Deputy Commissioner of the Department and during recent years has been Health Officer of West Hartford. At Yale University, he was Associate Professor of Clinical Pharmacology. DR. GRAY was the first Chairman of the American Conference of Governmental Industrial Hygienists, Chairman of the Industrial Hygiene Section of the American Public Health Association and a Fellow of the Association.

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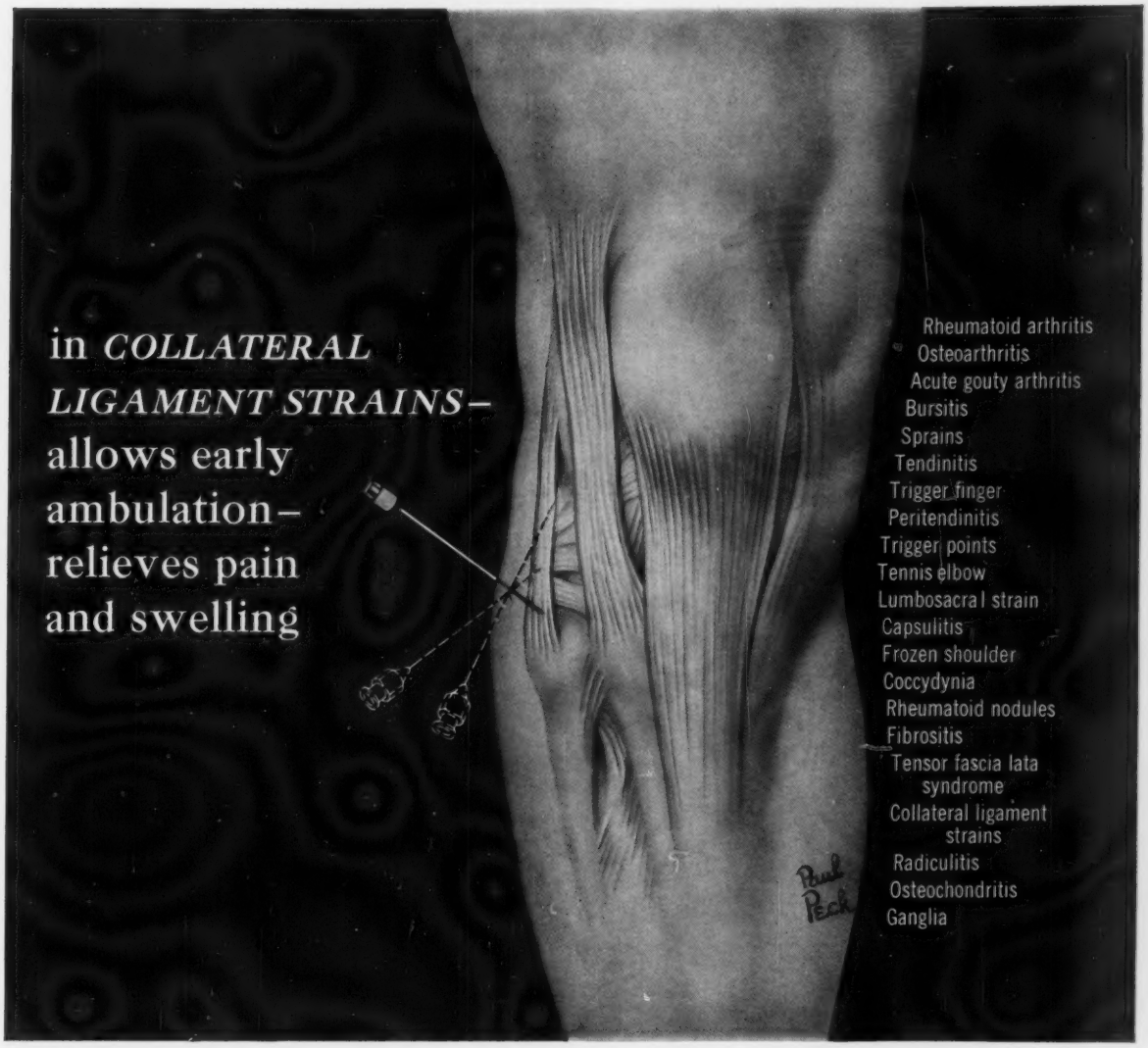

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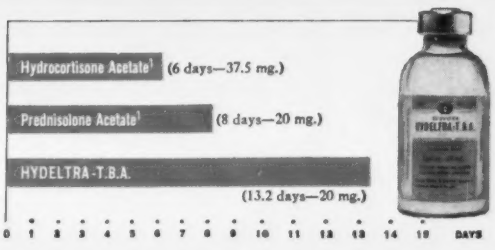
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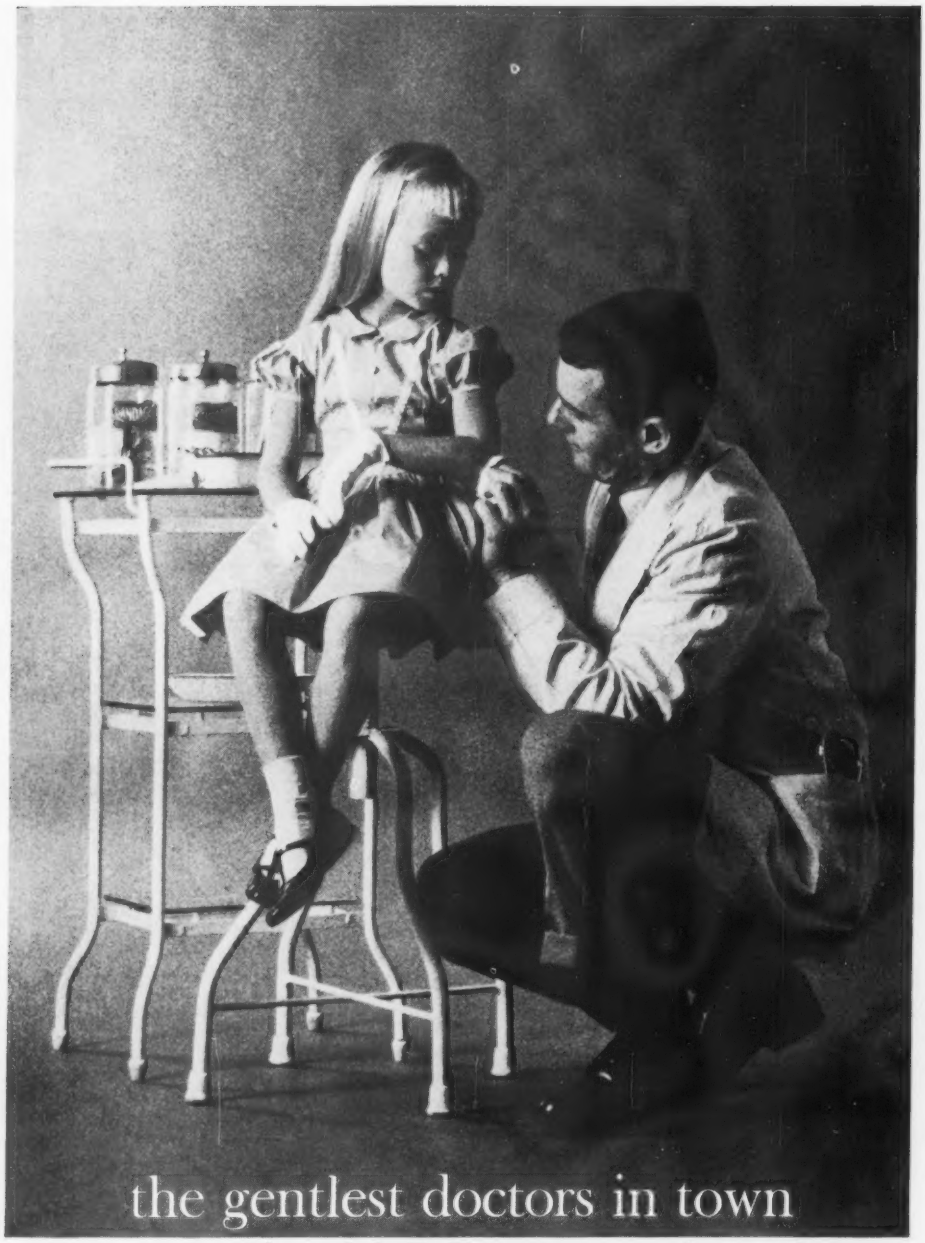

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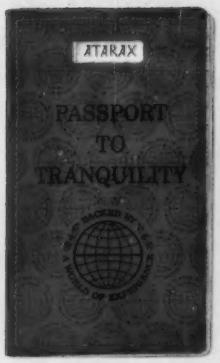

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1. Fuligrabe, E. A.: Ann. New York Acad. Sc. 68:192, 1957. 2. Jenkins, B. H.: J.M.A. Georgia 45:431, 1956. 3. Davis, O. F., et al.: Postgrad. Med. 26:719, 1959.

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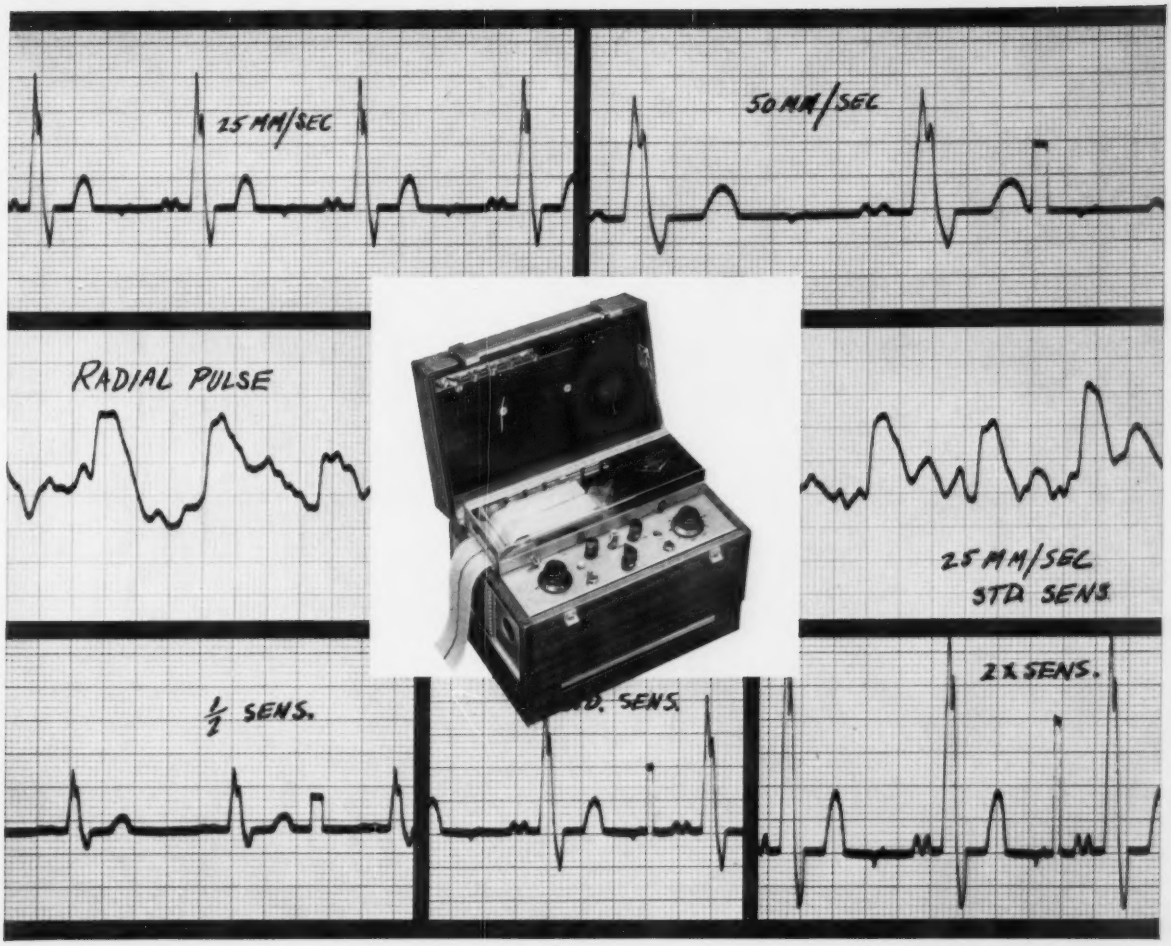

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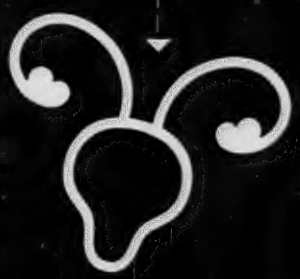

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Advantages:

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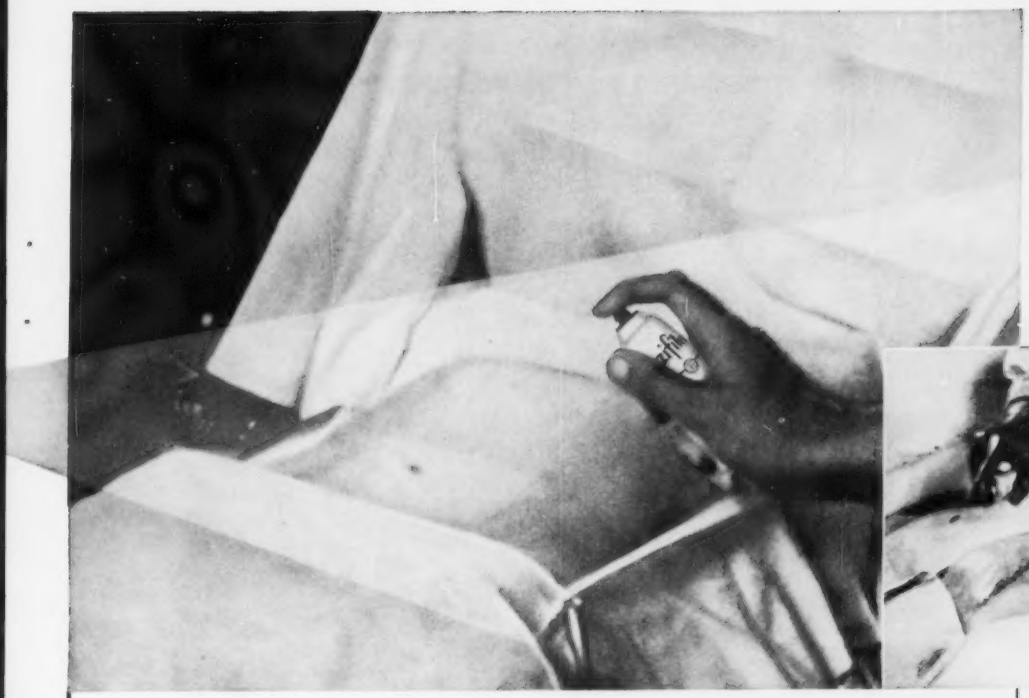
REZIFILM is *not* indicated as a dressing for second or third degree burns or for bleeding or granulating wounds.



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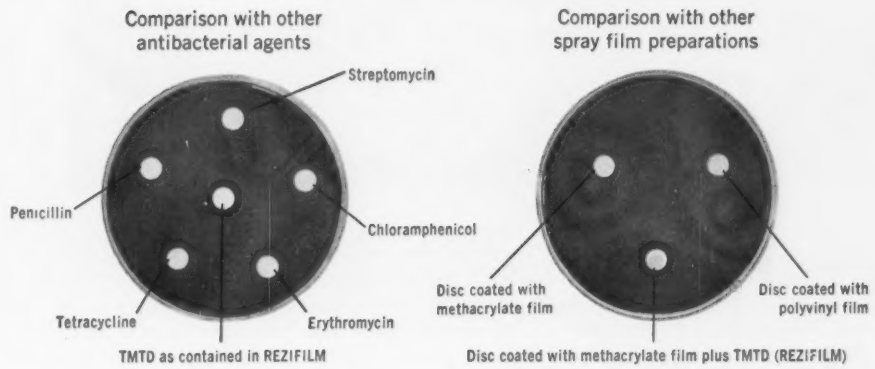
Compare the antibacterial activity of REZIFILM[6]



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An interesting 16 mm. color motion picture film (10 minutes) showing the use of REZIFILM *in surgery is available free of charge. Excellent for hospital and medical society meetings. Write to: Professional Service Department, Squibb, 745 Fifth Avenue, New York 22, N. Y.*

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References: 1. Eisenberg, G. M.: *Antibiotic Med. & Clin. Ther.*, 6:594 (Oct.) 1959. 2. Thomson, J. E. M.: Report to The Squibb Institute for Medical Research, June, 1957. 3. Maloney, J. V. and Mulder, D. G.: *Am. Surgeon* 23:388 (April) 1957. 4. Bucher, R. M.: Report to The Squibb Institute for Medical Research, July 3, 1957. 5. Hammond, J. A.: Report to The Squibb Institute for Medical Research, May 3, 1957. 6. Eisenberg, G. M.; Weiss, W.; Spivack, A. P.; Bassett, J. G.; Ferguson, L. K., and Flippin, H. F.: Adapted from Scientific Exhibit, A.M.A. Meeting, June 8-12, 1959.

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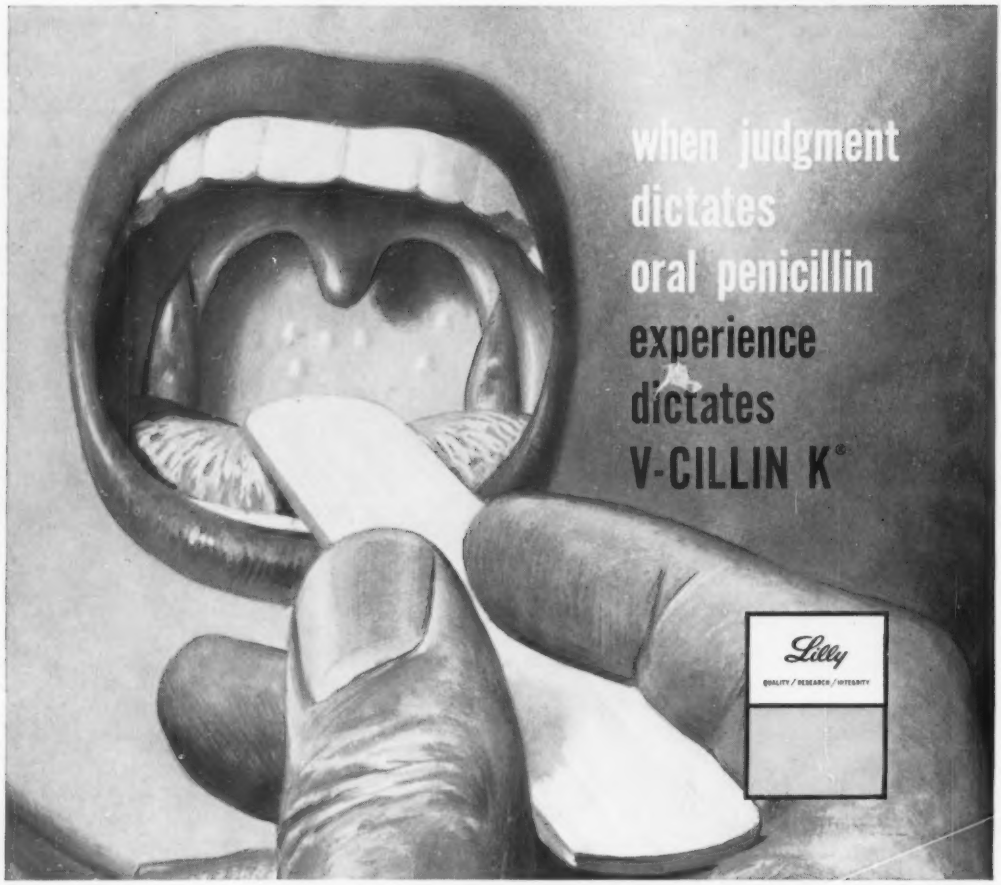

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1. Griffith, R. S.: Comparison of Antibiotic Activity in Sera Following the Administration of Three Different Penicillins, Antibiotic Med. & Clin. Therapy, 7:No. 2 (February), 1960.

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RETIREMENT

from the Viewpoint of a Medical Director

• WILLIAM P. SHEPARD, M.D.
Chief Medical Director
Metropolitan Life Insurance Company
New York, New York

The recent wave of discussion concerning the problems of the aging in general and their health needs in particular seems to stem mainly from two sources: (1) an increasing number of our senior citizens, and (2) another resurgence of the persistent efforts of certain groups to obtain health care in this country at Government expense.

It appears to be the philosophy of some of the latter groups that if this cannot be accomplished all at once, they will be pleased to obtain it first for one group, then another, preferably starting with a group such as those over 65 who have common problems and impressive voting power.

The increasing number of people over 65 in this country is an outgrowth of two major factors: economics, and medical and public health progress. People live better and, therefore, longer than before. This is in spite of wars, depressions, and booms.

Annual George H. Gehrmann Lecture, presented to the American Academy of Occupational Medicine, Williamsburg, Virigina, February 12, 1960.

We in medicine have had little to do with the economics of this phenomenon. We may pause to point out, however, that it is a testimonial to the success of our American heritage of self-determination and free enterprise — a principle so precious to the unfettered practice of medicine as we have known it in this country.

It is also important to look carefully at the predictions of a great increase in the number of aged in the next generation. While it is true that the actual number of those over 65 is expected to increase from about 15 million in 1958 to about 24.5 million in 1980, the rest of the population is also expected to increase. In 1958, those over 65 represented 8.6% of the total population. In 1980, it is expected that they will represent 10% of the total.[1]

Retirement Versus Health and Happiness

We in medicine have had much to do with adding years to human life. In a real sense, we are concerned with helping to make these added years as healthy and happy as possible. Does

retirement from industry at a given age really militate against a happy and healthy old age? Does it always do so? To approach the answers to these questions, let me recount some of the peculiarities of modern industry. Many of them are quite different from those ever encountered before. Even though these peculiarities may be unpleasant to some, they do represent facts of life. Industrial management and methods have been revolutionized during this generation in at least three ways:

1. Inventiveness and competition have necessitated in many industries the assembly-line method of production. Skilled handwork is all but disappearing and with it the lone worker whose skills and judgment increased over the years often to an advancing age. There are exceptions, to be sure, such as the tool and die maker and others. But in the main, the modern worker is a member of a large team, each of whom does one or two repetitive things hundreds of times a day or a week. What he does depends on the satisfactory completion of one or two other things by the man behind him. The man in front, ready to do his one or two things, depends on the satisfactory performance of the other two. If any individual along the line is absent, fails, or slows down, all the others are affected, the product is defective, the reject rate goes up and the whole team suffers in morale if not in earnings. These assembly-line jobs represent a large percentage of the jobs available in many industries today.

A well-known concomitant of aging in all of biology is slowing. Physical as well as mental slowdown is inevitable as the organism ages. It never occurs exactly on a given birthday. But for the great majority, it begins gradually before 50 and is slowly progressive throughout the balance of life. Most people at 50 can run a hundred yards, few can at 80, and almost none at 100. Slowdown is bad for the assembly-line. It not only decreases production but often rouses the ire of fellow workers. The aging worker is referred to as "the old man." Not always, but frequently, he becomes crotchety. If his seniority brings better pay, or if he occupies a superior position, there is much pressure from his fellows to displace him so that someone can be promoted. These are the hard facts that confront labor and management. They feel obliged to find some fair, impersonal way to handle this serious problem. There is much pressure within industry, both from labor and management, to get rid of the older worker.

2. Another revolutionary change in industry is hard on the older worker. This is the development of new methods of production, also due to inventiveness and competition. Thus, the steam locomotive engineer, with all his skill, experience, and pride in the great locomotives of yesteryear, must now learn an entirely new technique of operating a diesel locomotive. The textile industry in nearly all of its aspects has undergone marked revolutionary changes in techniques of production. The modern steel mill is highly mechanized. The manufacture and handling of synthetics was hardly heard of 25 years ago.

It is harder for the aging than for the young to learn new methods. One textile union, consisting largely of older workers, refused to learn new methods. The factory moved elsewhere and employed an entirely new group of inexperienced workers. The shaping of pottery in a press, so common today, is anathema to many of the older potters whose lifetime was spent at the wheel where they developed great skill. Bear in mind that these changes in management and methods are by no means confined to large industry. In fact, they have contributed to increasing the number of small industries through decentralization and subcontracting. Here the aging worker is often even more conspicuous, slow and resentful. From a medical standpoint, we know that his resentment and sometimes a part of his slowness is a result of his being pushed beyond his natural capacity.

3. Competition between industries in this country never has been so great. In order to forge ahead, or even hold its competitive position, an industry must depend on dynamic, imaginative leadership. Complacency spells doom in our rapidly expanding economy. Complacency, with slowing, is another concomitant of aging. Perhaps there has never been a time when business demanded so many able younger men to provide leadership. As well-trained young men gain experience and wisdom with their company, they must be encouraged by promotion and eventually a responsible position in the top ranks. Lacking this, they will be lost to competitors. Lack of a fixed retirement date may doom the industry to complacency and loss of competitive position. This applies to everyone from foremen to executives. Of course, the man who retires is often in good shape and capable of carrying on, but for the good of the business he must make room for his younger associates.

To be sure, some industries are large enough to allow shifting the aging worker to light work, but even in the largest plant there can be only so many watchmen, crossing guards and consultants.

The self-employed, including physicians, lawyers, and farmers, can and do make automatic adjustments. They differ from the miner and factory worker. Fritz Kreisler, who just passed

his 85th birthday, has not played in public for several years. Will Mayo stopped operating at age 67.[2] Older lawyers become valued advisors to their younger partners, seldom working full time. There are not many farmers over 70 who drive a horse hitched to a plow or even ride the tractor. Of course, they are still valuable and useful citizens, even revered in many cases. Nevertheless, they can no longer do the things they used to do. No more can the factory worker. He cannot make these adjustments on the assembly-line.

Need for an Impersonal Retirement Plan

Our great problem, as we in industrial medicine know so well, is that we have no way of measuring objectively the aging process either physically or mentally. Some day we may have, but I hope it will not come in my time. I would not relish having to tell an aging worker that he has failed the test and must, therefore, get out. Imagine his vehement condemnation of me and the test. There are, of course, subjective tests, and perhaps the best one is the aging individual himself if he will be honest, plus the observation of the foreman and fellow workers who can see only too clearly the beginnings and the progress of the slowing process. It is hard on anyone, from the foreman up, to have to say to an aging but faithful worker, "Get out — you're too old."

This is an old, old problem which has led management and labor over the years to pretty well agree on the necessity of some age at which retirement shall be the rule. This seems to be the only fair, impartial, and impersonal way available today. Some retirement plans are more flexible than others. Some start as early as age 62, many go to 67, a few to 70 — the average happens to be 65. Perhaps some are too strict, some too liberal. But some age must be set if all are to be treated alike. And all must be treated alike. If one exception is made, without the reasons being perfectly apparent to all, it means heartbreak for the others.

Financial Structure of Impersonal Retirement Plans

Having decided that retirement at a given age is necessary, fair, and reasonable to all concerned, it is amazing to see what elaborate plans management, labor, and government have made to soften the blow of retirement. The vast and growing extent of their pension plans is not generally fully appreciated.

Table I gives the latest data available and it is impressive.[3] At the close of 1958, over one-half of all civilian nonagricultural wage and salary workers were enrolled in retirement plans. In 1935, only a little more than one-fifth were so covered. Note that the number of persons covered has increased five times in 13 years. It should also be noted that this table excludes Old Age, Survivors, and Disability Insurance from the Government.

TABLE I.
NUMBER OF PERSONS COVERED BY MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
(In Millions)

Year	Grand Total
1935	5.6
1945	14.3
1955	23.0
1956	24.9
1957	27.0
1958	28.0

In Table II we see the numbers covered by the various types of plans.[3]

As I have pointed out, about one-half of all civilian, nonagricultural employees are already enrolled in retirement plans, excluding OASDI. This leaves substantial room for further advancement in coverage as well as in larger pension payments. Consequently, it seems to me pertinent to ask if it is wise for legislative compulsion to force specific benefits for retired people, such as hospitalization and medical coverage, at the expense of adequate pensions. Of what benefit is it to the individual to insist that he have the means to pay for surgery but then to permit the prospective patient to starve?

When we look at the assets and reserves of the major pension and retirement programs in the United States, we find another stupendous figure. Table III includes Old Age and Survivors Insurance in the amounts indicated for a total of $89 billion for 1958. It is an increase of nearly 141% since 1950.[3]

Since 1950, the aggregate of the assets and reserves of all retirement funds, including the OASI Trust Fund, has grown by more than $50 billion and now exceeds $89 billion. During this period, the assets and reserves of the private retirement plans have shown the fastest rate of growth, having more than tripled.

TABLE II.
NUMBER OF PERSONS COVERED BY MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES BY TYPE OF COVERAGE
(In Millions)
1958

Private Retirement Plans	
Insured	4.9
Non-Insured	15.5
Government Retirement Plans	
Railroad Retirement	1.3
Federal Civilian Employees	2.1
State and Local Employees	4.2
Grand Total	28.0

TABLE III.
ASSETS AND RESERVES OF MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
(000,000 Omitted)

Year	Grand Total
1950	$37,404
1955	68,795
1956	75,812
1957	82,269
1958	89,065

Table IV shows the amount of reserves and assets by type of plan.[3]

Let us look next at the benefits paid under major pension and retirement programs in the United States. This is shown in Table V. The total of all benefit payments in 1958 came to $9.4 billion, almost six times the comparable figure for 1950.[3]

Table VI shows the types of each plan paying these benefits in 1958.[3]

These are stupendous figures both in dollars and in men. They are pretty well agreed upon by others.[4,5] There is no reason to think that the rapid growth illustrated here will not continue if industry and labor are allowed to solve their own problems without legislative intervention.

No claim is made here that these benefits are adequate in every case, but the trend is in the right direction. What would be adequate might be difficult to define, for after all, whose salary is ever adequate, or savings, or life insurance?[6] May I ask how much worse off the aged as a group would be today without these enormous benefits? No matter how much the pension may be, it should always be obvious that the worker is expected to supplement his pension by some form of systematic savings starting at a fairly early age.

I have presented the genesis of and reasons for a fixed retirement rule in industry and have shown the elaborate plans and enormous financing which proves the earnestness of those who have devised these rules.

TABLE IV.
ASSETS AND RESERVES OF MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES BY TYPE OF COVERAGE
(000,000 Omitted)
1958

Private Retirement Funds	
Insured Pension Reserves	$15,500
Non-Insured	23,800
Government Retirement Funds	
Railroad Retirement	3,624
Federal Civil Service Retirement	8,677
State and Local Employees	15,600
Old Age and Survivors Insurance	21,864
Grand Total	$89,065

TABLE V.
BENEFITS PAID UNDER MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
(000,000 Omitted)

Year	Grand Total
1950	$1,593
1955	5,664
1956	6,589
1957	8,237
1958	9,350

Preparation for Retirement — Economics, Health, Interests

Now let us consider what retirement really means. The word retirement has come to have some unfortunate and some unnecessary connotations. It should not necessarily mean idleness. Perhaps we need a different word — one which merely connotes change of pace, or being one's own boss for a change, or freedom to do what one chooses without pressure from time clocks, production schedules, or deadlines.[7] Leo Wade suggests "preparing ourselves for our second career-retirement."[8]

It seems to me and others with whom I have talked that successful retirement depends mainly upon three factors: (1) income, (2) health, and (3) interests.

There may be little the doctor and nurse can do about income but it is surprising how often we have an opportunity in health counseling to remind the individual of proper preparation for his "second career," and to point out that he will want to supplement his retirement income with other savings, especially home ownership and periodic purchase of government bonds and life insurance.

There is evidence that income after retirement is improving markedly. According to Dr. Rita R. Campbell[9]:

"In December, 1958, there were 15.4 million individuals in the United States 65 years and

TABLE VI.
BENEFITS PAID UNDER MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES BY TYPE OF COVERAGE
(000,000 Omitted)
1958

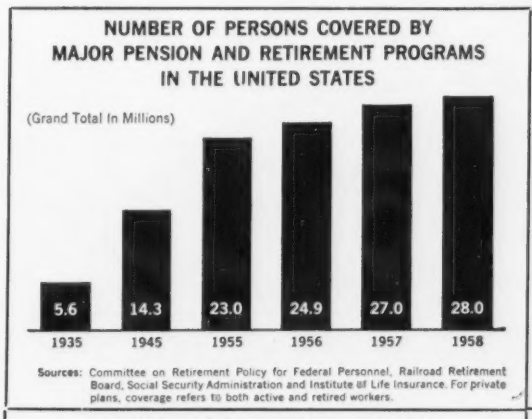
Private Retirement Plans	
Insured	$ 300
Non-Insured*	1,000
Government Retirement Plans**	
Railroad Retirement	449
Federal Civil Service Retirement	439
State and Local Employees	685
Old-Age, Survivors and Disability Insurance**	6,477
Grand Total	$9,350

*Includes refunds to employees and lump-sum payments under deferred profit-sharing plans.

**Payments under Government retirement plans and Old-Age, Survivors, and Disability Insurance refer only to benefits for old-age and service retirement.

older. Of the 15 million, somewhat less than four million were employed or wives of employed persons, nine million received OASDI benefits, and about two million, government pensions. In addition, one and one-quarter million aged received some form of private pension and an additional one million received annuities individually purchased. Fifty percent of all aged had some income from assets as interest, rent or dividends. On the other hand, 2.5 million aged received some form of public assistance.

"During the last decade the aged have been gaining income faster than the price level has been rising and thus have been able to improve their asset position considerably. The recent 1957 national survey of OASI beneficiaries reveals a striking improvement in the financial condition of the OASI aged beneficiary groups from 1951 to 1957. For example, the median net worth of a retired worker, with wife also entitled to benefits, has increased in the short space of six years from $5,610 to $9,616 or an increase of 71%. Even when these figures are adjusted for increases in the cost of living, they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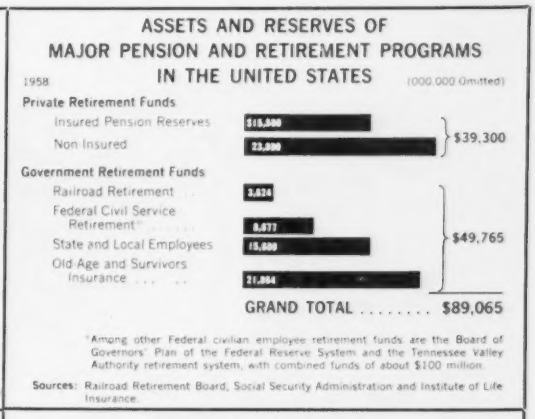
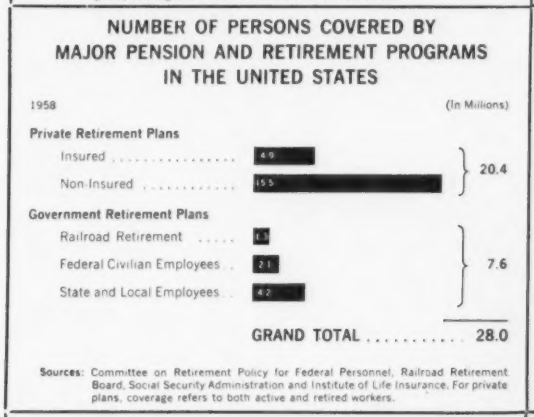
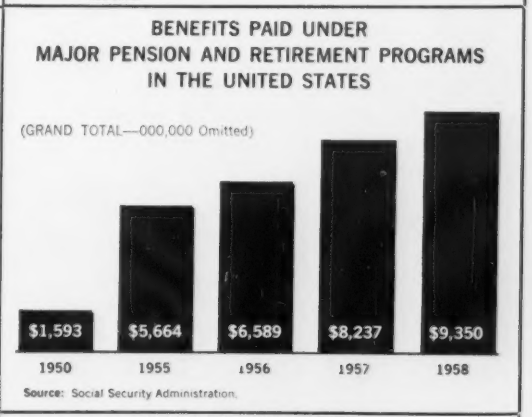
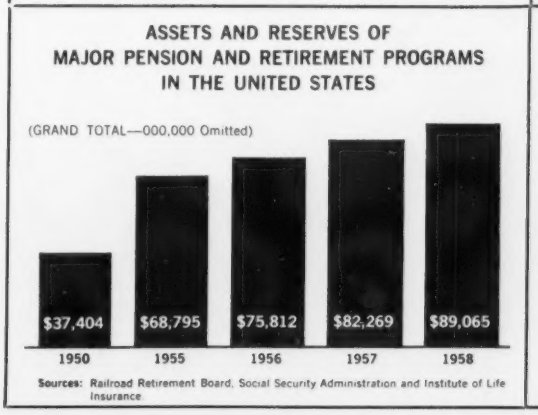
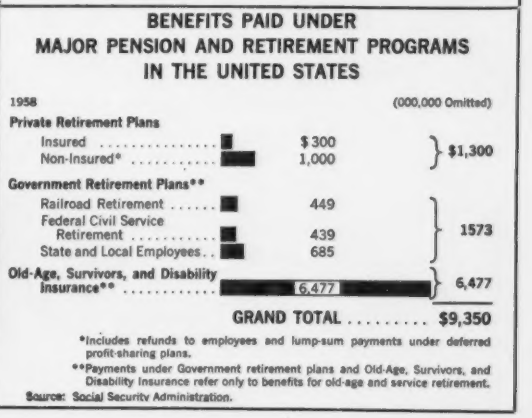
(Grand Total In Millions)
5.6
14.3
23.0
24.9
27.0
28.0
1935
1945
1955
1956
1957
1958
Sources: Committee on Retirement Policy for Federal Personnel, Railroad Retirement Board, Social Security Administration and Institute of Life Insurance. For private plans, coverage refers to both active and retired workers.


ASSETS AND RESERVES OF MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
1958
(000,000 Omitted)
Private Retirement Funds
Insured Pension Reserves
Non-Insured
$39,300
Government Retirement Funds
Railroad Retirement
Federal Civil Service Retirement*
State and Local Employees
Old Age and Survivors Insurance
$49,765
GRAND TOTAL $89,065
*Among other Federal civilian employee retirement funds are the Board of Governors' Plan of the Federal Reserve System and the Tennessee Valley Authority retirement system, with combined funds of about $100 million.
Sources: Railroad Retirement Board; Social Security Administration and Institute of Life Insurance.


NUMBER OF PERSONS COVERED BY MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
1958
(In Millions)
Private Retirement Plans
Insured
Non-Insured
20.4
Government Retirement Plans
Railroad Retirement
Federal Civilian Employees
State and Local Employees
7.6
GRAND TOTAL 28.0
Sources: Committee on Retirement Policy for Federal Personnel, Railroad Retirement Board, Social Security Administration and Institute of Life Insurance. For private plans, coverage refers to both active and retired workers.






BENEFITS PAID UNDER MAJOR PENSION AND RETIREMENT PROGRAMS IN THE UNITED STATES
1958
(000,000 Omitted)
Private Retirement Plans
Insured $300
Non-Insured* 1,000
$1,300
Government Retirement Plans**
Railroad Retirement 449
Federal Civil Service Retirement 439
State and Local Employees 685
1573
Old-Age, Survivors, and Disability Insurance** 6,477
6,477
GRAND TOTAL $9,350
*Includes refunds to employees and lump-sum payments under deferred profit-sharing plans.
**Payments under Government retirement plans and Old-Age, Survivors, and Disability Insurance refer only to benefits for old-age and service retirement.
Source: Social Security Administration.

show an increase in median net worth of 50%."

Some misleading figures have been used on this problem. We have been told that three-fifths of all people 65 and over had less than $1,000 in money income in 1956 and 1957. The fact is that "income per person" taken out of context does not present a true picture of the economic status of the retired aged person. It does not take into account family and nonmonetary income, total assets, other resources, and the reduced financial obligations of the aged person.[10]

A study by the Health Information Foundation shows that we are mistaken when we consider the aged a homogeneous group. Many are rich, many are poor — the majority are in-betweens. When a scientifically selected sample of the older population was asked, "How would you meet a bill of $500 for medical care?" 82% answered that they would meet it in whole or in part from savings, from current income, from life insurance, mortgages, health insurance, or from children and relatives.[10]

As to health, the medical department in industry can do much to assure health habits and health protective programs which are lifelong in their effect. The individual who has become well accustomed to a physical examination annually or oftener, who has learned from his physician to change bad health habits, thus retarding deterioration, that individual is given as much assurance as we can provide of a healthy old age.

As to interests, it is folly to think of an individual working at one job for 30 or more years, suddenly dropping it and finding new interests in unfamiliar fields. Very few people are truly one-interest persons. Almost everybody has numerous interests if only they can be encouraged to develop them.

If management can be persuaded to sponsor hobby classes after working hours, then it is easy for the medical department to encourage everyone with limited interests to develop outside activities.

One industry has 18 such classes running nine months a year. They are held from 5:15 P.M. to 6:45 P.M. semiweekly and are led by employees who are expert in one line or another. Among them are music appreciation, stamp collecting, sewing and dressmaking, cooking, cabinet work, wood carving, bird watching, sculpture, fly tying, bookbinding, decorative ceramics, painting, photography, gardening, flower arranging, and even fancy cake frosting.

Some employees become so successful that their hobbies supplement their income. One elderly lady, retired for 15 years, lives alone contentedly. She displays her beautiful hooked rugs on the rail of her veranda on fair days and has made enough selling them to pay part of the college tuition for her orphaned grandson. Her hobby keeps her occupied, but she has another reason for being satisfied to live alone. It is knowing that any day she becomes ill, a phone call to the plant will bring her a visiting nurse at once.

Whether we like it or not, much of the world's work is drudgery. Yet it must be done. Quite aside from their effect on successful retirement, hobby classes are an important morale factor for these thousands of workers who must do the dull, routine jobs. I know one garbage collector whose work is not the pleasantest in the world, but he likes it and has held the job for 20 years, because his hours are relatively short and he plays the piccolo in the neighborhood band. When his truck is full and the driver heads for the sanitary fill, Tony mounts the front seat, pulls his piccolo out of his pocket and pipes the smelly truck to the dump with everything from martial music to operatic arias. To me he says, "Doctor, for this I am famous!" Thus Tony has found his place in the sun, primarily through his hobby. He looks forward to retirement to have more time for music and to repair flutes and piccolos.[7]

In addition to hobbies, or perhaps as one of them, the retiree might well take an interest in politics where his mature judgment and years of experience can serve his city, state and nation. His participation in all forms of civic enterprise is useful, satisfying and welcome.

When the young or middle-aged worker can be persuaded that retirement is inevitable and that it should be intelligently and continuously planned for by attention to income, to health and to outside interests, compulsory retirement then becomes a fiction. Retirement is then voluntary.

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HAZARDS OF MICROWAVE RADIATIONS

A REVIEW

• KUO-CHIEW QUAN, B.E.E., M.D.
Washington Hospital Center
Washington, D.C.

Since World War II radar and other microwave equipment have come into use by the armed forces, by commercial aviation, by navigation, and, to a lesser extent, by medicine. While it is generally believed that microwaves in these applications are harmless, there are in the literature sporadic reports of injuries attributed to microwaves. It is apparent that exposure to high intensity microwave radiations may be injurious and that as a consequence certain ill-defined hazards are associated with the use of microwave generating equipment. (See DEICHMANN, WM. B., et al.: *Indust. Med. & Surg.*, Dec., 1959.)

The term *microwaves* is used to designate a certain portion of the electromagnetic spectrum and generally includes the frequencies between 1,000 and 30,000 megacycles per second, or, in terms of wave length, between 30 cm and one cm. Microwaves usually are produced with special electronic tubes such as the magnetron or the klystron. Microwaves possess certain properties in common with light; they can be reflected, refracted, diffracted, and absorbed. As a consequence they can be focused by a suitably shaped metallic reflector into a sharp beam, similar to that produced by a searchlight. Most radar sets produce microwave beams in this manner.

Applications

The optical properties of microwaves account for their extensive use for military purposes. A pulse of microwave energy is fed into a parabolic disk, called an antenna, which forms a sharply defined beam of microwave radiation into space. If the beam strikes an object capable of reflecting the radiation, such as an airplane or a submarine periscope, some of the energy will be reflected back to the antenna, where it is received and presented on an oscilloscope screen as a spot of light in a position that indicates the distance and direction of the reflecting object.

The more intense the transmitted beam, the greater the distance from which a useful signal will be received and the more time there is to do something about it. Hence the considerable incentive to increase the power of microwave generators. Peak powers of a million watts are not unusual.

Two radar bands are now in common use: the "S" band, with a frequency of 2,880 megacycles and a wave length of 10.4 cm, and the "X" band, with a frequency of 9,375 megacycles and a wave length of 3.2 cm.

Microwaves are used in clinical medicine as a means for heating tissues beneath the skin and subcutaneous fatty layers. The diathermy application depends on the fact that heat is produced wherever microwave, or any other energy, is absorbed. Microwave diathermy is used when a local increase in blood circulation and metabolic rate is considered beneficial. Success is claimed for microwave therapy in the treatment of certain musculoskeletal conditions such as fibrositis, bursitis, osteoarthritis, and rheumatoid arthritis; for certain eye diseases like iritis, cyclitis, senile macular degeneration, and retrobulbar neuritis; and, to a lesser extent, for certain pelvic inflammatory diseases and skin conditions.

Microwave diathermy machines typically have a frequency of 2,450 megacycles, a wave length of 12.2 cm, and a power output of 125 watts.

Absorption of Microwave Energy in Tissue

Any biological effect, beneficial or harmful, produced by microwaves can result only from absorption of energy by the tissues. The amount of energy absorbed by a small volume of tissue in a large mass of tissue subjected to microwave radiation depends on a number of factors:[9,10]

1. The intensity or field strength of the microwave radiation incident on the surface of the tissue mass.

First Award of Michigan Industrial Medical Association's Women's Auxiliary for 1959, Manuscripts on Occupational Health.

2. The duration of the exposure.

3. The frequency or wave length of the microwave radiation.

4. The thickness of tissue between the irradiated surface and the small volume of tissue.

5. The composition of the tissue.

The degree of temperature rise produced in the small volume of tissue will depend on the five factors above and on the ability of the irradiated portion of tissue to rid itself of excess heat.

It should be noted particularly that the energy deposition in tissue is dependent on the microwave frequency and on the composition of the tissue. The relation between these two factors and the amount of energy absorbed in any given set of circumstances is complex and is at present subject neither to theoretical calculation, nor to accurate empirical prediction.

Biological Effects of Microwaves

On purely physical grounds it can be said that the absorption of energy from microwaves, or from any other penetrating radiation, will raise the temperature of the absorbing material. If the absorbing material is the tissue of a living mammalian organism, the temperature elevation will set in motion a complex sequence of homeostatic mechanisms that tend to restore the normal temperature. Under steady state irradiation conditions an equilibrium will be attained at a temperature somewhat higher than normal. The human body is capable of dissipating heat at a rate on the order of 0.01 to 0.1 watts per square centimeter of body surface. Thus, the average human body is able to absorb between 100 and 1,000 watts of energy from an outside source like microwaves, while still maintaining an equilibrium, but an elevated temperature.[20] Higher rates of energy absorption will overpower the regulatory capabilities of the body and lead to a continuous temperature rise and ultimately to death.

All tissues of the body are not equally equipped for heat dissipation and temperature regulation. The lens of the eye and the hollow viscera such as the gall bladder, the urinary bladder, and parts of the gastrointestinal tract, for example, are comparatively avascular and largely devoid of effective temperature regulating mechanisms. It is reasonable to expect that such organs will suffer relatively larger temperature rises and will be more likely to injury by microwave irradiation than other body organs. Experiments have in fact shown that severe and injurious temperature increases occur in these organs under microwave irradiations accompanied by only slight increases in rectal and oral temperature.

It is not clear whether all the biological effects of microwaves can be attributed solely to the temperature increases that result from energy absorption, or whether these effects are produced in part by mechanisms other than simple thermal elevation. Hines and Randall[9] were unable to find any crucial experimental evidence for biological effects unrelated to temperature change. It should be pointed out, however, that at this time it is impossible to rule out completely the possibility of athermal effects of microwaves.

Experimental Evidence in Laboratory Animals

Hines and Randall[9] in 1952 reported the pronounced effects of high intensity 10 centimeter microwaves on laboratory animals. Rabbits exposed to a constant 3,000 watt field for 75 seconds were killed instantly, and a 30 second exposure produced death within two minutes after the irradiation was terminated. At this same power level a rat was killed by a 22 second exposure. A hamster exposed to a 4,000 watt field died immediately after a 10 second exposure.

These lethal effects are attributed to a generalized increase in body temperature which ultimately leads to a thermal paralysis of the respiratory center. Irreversible cellular injury and death may occur when tissue temperature is maintained 5° C above the normal body temperature. Irreversibility of the injury depends on the duration of the hyperthermic episode; the higher the temperature the shorter the time necessary to cause cell death.

It was observed that when only a limited area of the body, such as the abdomen, was irradiated, the temperature of the visceral organs was markedly elevated despite normal and rectal temperature. Studies with relatively low power levels showed that the rise in brain temperature is not the primary cause of death when the abdomen alone is irradiated, but that elevation of brain temperature is probably the primary cause of death when only the head is irradiated. Oldendorf,[14] employing 12.5 centimeter microwaves, demonstrated that irradiation of the head of rabbits destroys brain tissue without apparent injury to the skin.

The cause of death from abdominal irradiation is usually attributed to shock; in other words, the mechanism of death is not understood. It is postulated that tissues respond to heat denaturation with an aseptic inflammatory reaction and are as a consequence prone to infection. This in turn may lead to peritonitis and shock. Boysen[3] studied whole body radiation in experimental animals using a 350 megacycles microwave generator with a power output of five to 500 watts. He observed hyperemia, hemorrhage, and necrosis in the bowels of irradiated animals and found the jejunum and ileum particularly susceptible

to microwave radiation. Hyperemia of the spleen and hemorrhage into the myocardium were also observed. In addition, bloodless diarrhea ensued in each instance.

Although the precise temperature at which injurious effects are first noted has not been determined for all tissues, it is known that it varies for different tissues. It is well known that the testes undergo degenerative changes when maintained for a considerable period of time at a temperature equal to that found in the abdominal cavity. Severe testicular damage has been produced in animals by microwave irradiation. Studies of the effects of 12 centimeter microwaves upon the testes of adult rats have shown that a single 10 minute exposure caused testicular degeneration at a temperature of only 35° C measured in the central area of the gland.[11] No evidence of any damage to the epidermis was found despite the pathologic changes which occurred in the interior of the gonads.

Cataract production is a frequently reported microwave injury. Microwaves of about 10 centimeters tend to produce maximum heating in tissue about one centimeter below the irradiated surface. Studies by Richardson, et al.,[14,15] showed that rabbit eyes exposed for 15 minutes at a distance of five centimeters from a 100 watt source of 12 centimeter microwaves developed lesions of the eye resembling cataracts in three to nine days after the exposure. A series of repeated exposures to a lower power level at the same frequency produced cataracts in from two to 42 days.

These cataracts varied from small posterior polar masses to almost complete involvement of the lens. The thermal coagulation of the protein in the cells of the lens is believed to be responsible for the formation of these lesions.

It was found in studies carried out on rabbits irradiated with 12 centimeter microwaves that greater temperature increases occurred in tissue containing metal implants than in control tissues.[17]

It is believed that the microwave radiation is reflected back by the metal plate and that standing waves are set up in the tissues between the metal plate and the irradiated surface. The energies of the reflected wave is added to that of the original radiation so that a greater temperature increase occurs. The effect of a metal implant depends on the depth of the implant and the wave length of the microwaves. This may have significance to people with metal bone implants, metal plate covering a cranial defect, or retained wire sutures in the body. Such people may be quite vulnerable to tissue damage from exposure to microwave irradiation in the region of the foreign body.

Injuries in Man

Studies by Daily[6] and by Lipman and Cohn[8] have shown no harmful effects of microwave irradiation to man. On the other hand, there are occasional reports of such injuries in the literature.

A case of bilateral cataracts in a 20 year old radar repairman was reported in 1952.[21] A few months later, Hirsch and Parker[10] reported similar lesions in a 32 year old technician who had operated a 100 watt microwave generator in the range of nine to 18 centimeters for 11 months. This man was in the habit of placing his hands and head in the microwave antenna to determine whether the generator was operating. The lenticular opacities in this case resemble the nuclear type produced by microwaves in experimental animals. There was, in addition to the lenticular opacities, a choroiditis of the left eye that may have resulted from the microwave exposure.

McLaughlin,[12] in 1957 reported a fatal case of accidental exposure to microwaves in a 42 year old white male. The validity of ascribing this fatality to microwaves has been vigorously protested. It has been denied that any exposure occurred, and further, that the cause of death was an ordinary ruptured appendix accompanied by generalized peritonitis. At this time the McLaughlin findings are neither accepted nor rejected; the case is cited here chiefly to note that it is a matter of active controversy.

Although no permanent injury has been reported from microwave exposure of people with metal implants in their bodies, reversible physiologic changes have been described by Rieke.[17] He reported a case of postinjury swelling in the hand of a 58 year old carpenter who had a stainless steel plate implanted in the proximal phalax of the left index finger for a compound fracture, and whose hand and finger were supported by an aluminum splint. Following an uneventful postoperative course, the patient returned to work some 22 days after the injury and noted the onset of swelling and pain in the left hand, which persisted and was unexplained in the next two weeks. He worked near a high frequency glue drying machine and it was later realized that he had been receiving unplanned diathermy owing to exposure to this radiation at work. The swelling and pain disappeared when he stayed away from the machine. The swelling and pain in this case may be explained on the basis of the heat induced in the steel plate and aluminum splint by absorption of the radiation energy. This phenomenon has been confirmed by the animal experiments described earlier.

Prevention of Injury

The increasing use and increasing power of microwave equipment in the armed forces, in navigation, in communications, and in medicine, and the possibility that microwave radiation may produce biological injury indicate the wisdom of preventing inadvertent exposure to these radiations. People most liable to accidental exposure are those who operate or service high power radar equipment. The most obvious form of protection is to prevent people from entering radar beams. The radar beams should be pointed toward unoccupied areas when possible; metal screens may be used to shield out the radiation; lights may be installed to warn personnel that the radar set is on and to indicate the boundaries of the beam; people who work in the vicinity of radar equipment can be supplied with photographic flash bulbs to warn them when they are exposed to intense microwave fields. Perhaps people with metal implants in their bodies should be excluded from work with such equipment.

The potential hazards of microwave diathermy are considered by many to be much less than the hazards associated with radar equipment. The justification for this view is that the power output of the diathermy machines is so much smaller than that of radar equipment. This specious argument disregards the fact that it is not the power output of the device that determines its hazard, but rather the amount of energy that it deposits in tissue. The physical and biological situation in tissue irradiated by microwaves to the extent that a temperature rise of 3° C is produced is the same whether the radiation is delivered by a diathermy machine or a radar transmitter. A backward glance to the once fashionable use of radium salts and x-rays may not be out of place.

In cases where microwave diathermy is considered to be the treatment of choice, such vulnerable organs as the testes and eyes can be protected by close-fitting metallic screens. Extreme care should be exercised in the application of microwave diathermy to patients with metallic implants to prevent excessive heating and tissue damage.

Treatment

There is no suitable treatment once irreversible damage has occurred. Shock resulting from prolonged local body irradiation should be treated by maintenance of blood pressure with a vasopressor, infusion of blood or fluid, and supportive therapy. Should respiratory embarrassment be found as the result of whole body irradiation, artificial respiration and oxygen should be administered, and a means for rapid cooling of the body should be provided. There is as yet insufficient clinical experience to prognosticate the course of this type of illness; therefore, any prognosis should be guarded in these patients until more is known about microwave radiation.

Summary

A brief account of the generation, applications, and the effects of microwave radiation is given. Evidences of the injurious effects from exposures to the microwave radiations in experimental animals as well as in human beings are briefly presented. Although no concrete evidence proves that injury or damage occurs as a result of casual association with this form of energy, it is well to point out to those concerned with the use of microwave energy the potential hazards of microwave radiation so that the use of this form of energy will be accompanied by appropriate respect and precautions.

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DRUG EVALUATION in INDUSTRIAL MEDICINE

— Purposes and Procedures

• BERNARD BEHREND, M.D. • ESTHER JAEGER, R.N.
Hospital of the Woman's Medical College of Pennsylvania
Philadelphia, Pennsylvania

More and more new drugs are being introduced to the medical profession, and some of them promise to be useful in occupational medicine. Before they can be adopted for routine use, however, we occupational physicians may have to determine whether they meet the special requirements of therapy for the working patient. This may be done informally by trials in daily practice. Or it may be done systematically by a special study designed to test suitability of the drug under special conditions of a particular industry or to measure certain characteristics of the drug. In either case, because extraneous factors can influence patient response, we need reliable techniques for assessing the drug's effects. Some techniques for this purpose are discussed in this report.

Those of us who have an opportunity to conduct systematic drug studies in an industrial setting have certain advantages not found in private practice. Probably the most important is an excellent opportunity for follow-up of patients during and after treatment. In fact, in an industry of low turnover, it is usually possible to observe patients at frequent and regular intervals. A second advantage is that, sometimes, there are available for study more patients with certain disorders (for example, common cold, headache, dysmenorrhea) than there are in general practice. Third, we can see first-hand the effect of emotional stress in the office or factory environment, and can assess its role in drug response. On the other hand, we must remain aware of the limitations and ethical considerations inherent in studying drugs in workers. We usually need management and worker approval before undertaking a study. Any treatment to be evaluated must not infringe on the practice of the employee's personal physician. Finally, the choice of drugs which we can study is limited by, and should naturally be confined to, the indications customarily treated in industry.

The following list shows the illnesses commonly treated at a clothing factory where I serve as part-time physician:

MOST COMMON ILLNESSES TREATED*	
Psychosomatic	4%
Headache	6%
G.I.	7%
Orthopedics	8%
Dermatologic	9%
Injuries	11%
E.E.N.T.	15%
Respiratory	21%
Other	19%

*One-year survey at Louis Goldsmith, Inc., Philadelphia.

This list of disorders, probably typical of those seen in a nonhazardous industry, suggests a variety of drugs suitable for study:

analgetics	stimulants
cold "remedies"	tranquilizers
antihistamines	vaccines
antitussives	topical antibiotics
nutritional aids	uterine relaxants
anorexigenic drugs	dermatological preparations
antipruritic drugs	

The test drug may be a new one whose safety has been established, or it may be an old one which appears useful in a new indication or useful in combination with another drug. In any case, we should, of course, first become

thoroughly familiar with the drug's probable actions and degree of safety — information available from the manufacturer of the drug.

Problems in Evaluating Drugs

The major difference between a clinical drug evaluation and an experiment in the physical sciences is that clinical findings are based upon the responses — often subjective responses — of patients. As such, some will be frightened, expectant, susceptible to suggestion, resistant to illness, trusting or suspicious of the doctor, worried about their family or job. Both the patient's present environment and past experience may affect his response; therefore, sorting out the factor which produced the observed effects may be difficult. Lest we be discouraged by the problem of evaluating treatment, we should remember that every doctor does this in his everyday practice. Part of the fascination of medicine comes from analyzing the physical and emotional factors which make the patient act as he does. To those of us who enjoy dealing with our patients as people, the evaluation of drugs will provide an interesting and rewarding task. If acceptable technique is coupled with careful observation, the resulting data also will be helpful to our colleagues.

Designing a Study

The first step in designing a study is to decide what questions we want the experiment to answer.[1] We may want to determine the therapeutic activity of the drug. We may want to do a controlled study comparing the recovery rate of patients receiving the drug to that of patients receiving no medication. Or we may want to compare the new drug with the standard drug used in the treatment of the illness.

Studies are most likely to yield useful results if their objectives are modest, specific, and precisely stated. For example, a study might be more useful if it asks, "Does the drug reduce the frequency of migraine headaches?" rather than, "Is the drug useful in treating headache?" Also, the criteria for rating the results should be specific. For instance, alleviation of a particular symptom has more meaning to other physicians than the over-all clinical judgment, "much improved." Finally, the indication being treated should be limited to the conditions in which the drug is expected to be most effective. If definite objectives, criteria, and indications are kept in mind when the study is designed and executed, haphazard accumulation of dissimilar data which defy summary or interpretation will be prevented.

In selecting patients for the study, we must sometimes consider the effect upon the results of age, sex, social status, personality, and other factors in addition to the condition or illness being studied.[2,3] We try to avoid studying a group of patients so atypical as to invalidate any conclusions regarding the general usefulness of the drug. Generally speaking, the predictive value of the study is greatest if the patients are representative of the general population.

Recording results is most difficult when evaluating drugs which produce a subjective response. The difficulty is that the most vital part of the study — the observation of results — is delegated to an untrained, sick, prejudiced, sometimes uncooperative individual with no interest in the quality of the study. To make the best of the situation we can try to avoid the further hazard of asking the patient to report his reactions to treatment several days *after* the experience. Several schemes have been devised to reduce our dependence on the patient's memory — daily report cards, telephone reports — but none of these methods are as reliable as seeing the patient each day. In this respect, when studying patients on the job, we in occupational medicine have a real advantage over the outside practitioner.

Occasionally, a report of a preliminary study is criticized for failing to account for other variables affecting patient response. For instance, changes in the patient's condition which we assume to be drug effects may actually result from spontaneous improvement, suggestibility of the patient, or extraneous environmental changes. Often the refinements needed to reduce the effect of extraneous factors are impractical in the situation in which the study is done. Admittedly, presently available techniques of drug evaluation are sometimes inadequate, but important advances in chemotherapy are being made despite our imperfect evaluation techniques. No doubt, the common-sense, clinical judgment, and interpretive skill of the investigators using these techniques deserve much of the credit for these advances. However, the preliminary report is justly criticized if it does not, at least, recognize the limitations inherent in the technique used. A preliminary study, though valuable, should not be interpreted as the definitive or final evaluation of the drug's usefulness. Such evaluations must incorporate formal controls into the study design.

Experimental Controls

A control is a standard or base line for comparison; therefore, all studies in which a comparison is made have some sort of control. The clinician may be comparing the experimental drug to remedies he has previously used; sometimes such historical controls are the only ones

feasible. However, we cannot be certain that the patients now taking a drug are comparable to former patients treated with older drugs, particularly when detailed records of the former treatment are not available. Therefore, the data are more convincing if the control and test groups are studied at the same time with the same thoroughness. Three techniques are suggested in the literature; each technique seeks to insure that the test group and control group are comparable and are treated alike in all respects except the drug being tested.

First, if there are enough patients, random assignment to separate groups will insure that the test and control group are comparable. If chance is to assure balance, this technique demands a large number of patients and, therefore, is expensive and time consuming.

A second technique attempts to match the groups in respect to age, sex, education, economic and social class, type and severity of disease, over-all health, weight, or any other pertinent quality. The patients usually are divided into homogeneous groups according to characteristics known to influence their response; then the members of each group are assigned at random to the study or control group. For example, if age must be balanced, the patients might be divided into those in their 30's, those in their 40's, and those in their 50's. Then members of each age group would be given the test or control drug *at random*. The effect is to balance the control and test group in regard to factors known to affect response, leaving unknown factors to be balanced by chance.

The third technique uses the patient as his own control. The patients are divided into two groups. One group receives the test drug for a period of time while the other receives the control drug. Then the group receiving the test drug is switched to the control drug, and the group receiving the control drug is switched to the test drug. This is the surest technique because the control and experimental subject are the same person; however, the technique can be used only when the patient's illness is stable over the period required for the study.

Thus, the control principle does not prevent the patient's personality and environment from influencing his reaction to the drug. However, it compensates for them by insuring that they exert equal influence in the control and test groups.

The Double-Blind Technique

The double-blind technique has received so much attention in recent years that mentioning it in connection with a drug study lends an aura of reliability to the data and authority to the conclusions. Of course, the double-blind technique does not insure infallibility, but it does eliminate the influence of the physician's bias and the patient's expectations.

The double-blind technique requires that all drugs compared in the study be indistinguishable to both the physician and the patient. This is achieved by labeling the drugs with a code number (usually, by the manufacturer) so that their identity is revealed only after the experiment is complete and the data are recorded. Thus, the technique makes guarding against bias unnecessary in the observation and interpretation of results. Unfortunately, use of the double-blind technique is not always possible. It makes adjusting of dosage levels to the needs of the individual patient difficult. More important, many drugs have unique actions or side effects which immediately reveal their identity to the physician and the experienced patient.

The Placebo

Within the past several years, several fascinating studies have revealed interesting facts regarding the placebo. First, placebos are highly effective — approximately 35% effective according to Beecher.[4] Secondly, the placebo's range of effectiveness is wide, not only giving relief in pain and hypotension, as might be expected, but also producing changes in blood counts and sodium and other blood serum constituents (probably through action of the adrenal glands). Placebos can relieve severe as well as mild symptoms. For example, Beecher found that the placebo effect is greater in severe pain than mild pain.[5] Third, placebos may produce side effects including nausea, drowsiness, dry mouth, dermatitis, sweating, eosinophilia, and tachycardia. Fourth, there is no evidence to support the belief that placebo reactors, as a group, are more prominent in one age group or sex than in another.

Because about one-third of all patients will react to the capsule or syringe no matter what its contents, many patients selected for any study will be incompetent to judge an active drug from a blank. By administering a placebo to the control group, a rough estimate of the number of placebo reactors in the sample can be obtained and their inevitable exaggeration of the therapeutic effect and side effects can be assessed.

However, the use of the placebo in drug studies is often barred for ethical reasons.[6] To make certain that each patient receives effective medication, studies in industry are often done by comparing the test drug to the proved drug currently considered most effective for the indication being tested.

Use of Statistics for Analysis

The statistical analysis of data in a study report sometimes imparts as much prestige to the study as the double-blind label.[7] As with the double-blind technique, statistics do not insure reliability of the conclusions reached, but if the study is otherwise properly designed and conducted, statistics are helpful in assessing the significance of the data.[8] Statistical significance means the findings are unlikely to have been a result of chance. To put it another way, if the study were repeated using a very large series of patients from the same population as the original study, the conclusions rarely would be reversed by the new study.

Example of A Drug Study Design

Recently we evaluated a combination of drugs among workers in a clothing industry. Our purpose was to test the value of adding a tranquilizing drug to the aspirin-phenacetin-caffeine (APC) combination usually prescribed for relief of mild and moderate pain. APC tablets identical in appearance and taste to the APC+ tranquilizer combination were supplied by the manufacturer. One hundred serially-numbered envelopes were prepared. Fifty numbers were randomly assigned to each drug by simply listing beside the envelope code numbers 100 numbers taken in order from a random numbers book[9] as follows:

Envelope Code Numbers	Random Numbers	Drug
...	.....	.....
11	39168	APC
12	56241	tranquilizer + APC
13	48690	APC
14	89633	tranquilizer + APC
15	93877	tranquilizer + APC
16	73949	tranquilizer + APC
17	70860	APC
18	13601	tranquilizer + APC
19	19044	APC
20	20260	APC
etc.	etc.	etc.....

APC tablets then were assigned the envelope code numbers appearing beside the even random numbers, and APC + tranquilizer tablets were assigned the envelope code numbers appearing beside the odd random numbers, as shown in the right hand column above. The code thus developed was placed in a sealed envelope until the experiment was completed so that neither we nor the patients knew the identity of the drug used.

The envelopes of tablets were distributed in numerical order to patients complaining of pain which seemed likely to benefit from a tranquilizer-analgesic combination. Primarily these patients had headaches or myalgia in which an emotional origin or emotional component seemed likely. In addition to the medication, each patient received a card questionnaire (Figure 2) on which he recorded the time each pill was taken, the degree of pain relief realized, and any mood alteration he experienced. The completed card was returned the following day, and the patient was further questioned regarding his reaction to the medication and the answers recorded on a form prepared for the purpose (Figure 1).

After completion of the 100 patient study, the code was broken and the case histories were analyzed. Within the limits of the study design, the results indicated no significant difference in analgesic or mood elevating properties of the two tablets. Although in this study this particular tranquilizer-analgesic com-

NAME: DATE:
NUMBER:

Please complete & return	AFTER TAKING PILL, HOW DID YOU FEEL?			DESCRIBE PAIN RELIEF AFTER TAKING PILL		
	Better	Same	Worse	Complete	Partial	None
1st pill taken a.m. / p.m.						
2nd pill taken a.m. / p.m.						
3rd pill taken a.m. / p.m.						
4th pill taken a.m. / p.m.						

(Please see reverse side)

Describe your feeling after taking medicine:

( ) Back to normal ( ) More energy than usual
( ) Nervous ( ) Able to work better
( ) Relaxed ( ) Sleepy
( ) Depressed ( ) No change
( ) Other: _____

COMMENTS:

Figure 1

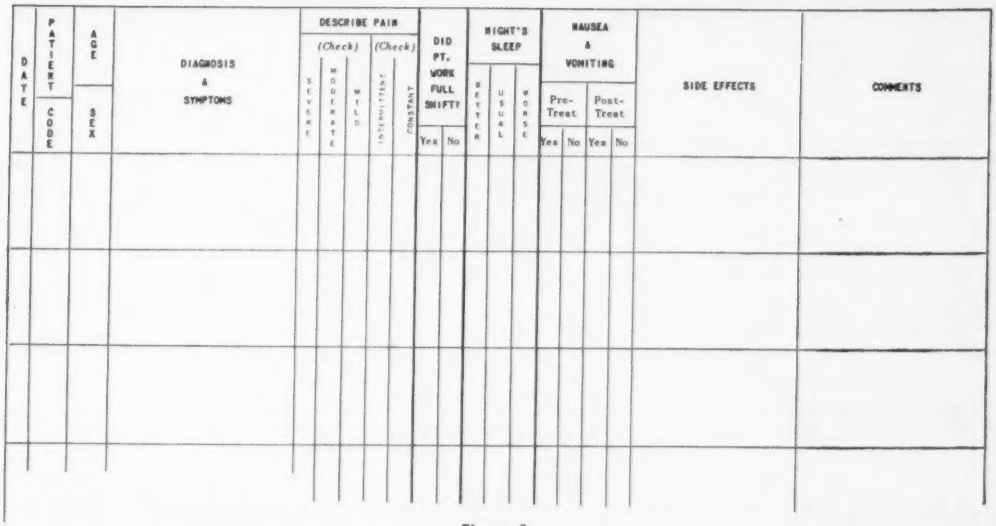

Figure 2

bination seemed to offer no advantage over APC alone, it must be admitted that a more extensive study with a larger sample might have revealed some difference not demonstrated in this small sample.

Summary

The drugs and illnesses described in this example are typical of those which can be safely and profitably studied in industry. The example also illustrates several of the techniques for evaluating drugs which were described in the preceding text: the randomly-selected control group, comparison to a standard drug, the double-blind technique, and a typical method for recording results. Not illustrated in the study example but discussed in the text are three other types of control (historical controls, balanced control groups, and the patient as his own control) and the use of the placebo and statistics in drug studies.

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Nation's Health Resources

Secretary of Health, Education, and Welfare Arthur S. Flemming has sent to the Congress a draft bill to strengthen and augment Federal and Federal-State programs directed toward improvement of the nation's health resources in the critical fields of professional health manpower and of facilities for patient care.

The proposed legislation which is comprised of four titles would: (1) revise, consolidate, and improve the Hospital and Medical Facilities Construction Grant Program, now authorized by Title VI of the Public Health Service Act; (2) amend Title VII of that Act to authorize a five year program of construction grants for teaching facilities which would expand the training capacity of schools of medicine, dentistry, osteopathy, and public health; (3) authorize a five-year program of project grants to schools of public health, and to those schools of nursing and engineering which provide post-baccalaureate training of public health nurses and engineers, to expand graduate public health training; and (4) authorize a five-year program of credit assistance in the construction of group practice facilities, with the Federal Government guaranteeing payment of the debt service on obligations issued to finance such construction.

The Use of
Gammacorten (Dexamethasone) in Acute Periarticular Rheumatism

• HERMAN H. TILLIS, M.D.
Chief of Arthritis Clinic
United Hospitals of Newark
Presbyterian Unit
Newark, New Jersey

Rheumatic diseases involving soft tissues are the most prevalent causes of chronic illness in this country, ranking second only to mental illness in temporary and permanent disability. Indeed, both the acute and chronic types of soft tissue rheumatism are encountered by physicians in their everyday practice. It has been observed in all ages, from childhood to the very elderly. Acute cases may respond readily to treatment, but recurrences are frequent. Few of us escape an experience of this sort in the course of a lifetime. Almost every muscular and articular region of the body may be affected. The resulting symptoms vary in severity from a mild aching, which may be merely a nuisance, to a deeply disabling and violently painful illness.

Before the advent of corticosteroids, many chronic cases persisted for years and were exceedingly resistant to the usual forms of treatment. Salicylates are inadequate for the more severe types of soft tissue rheumatism. Prior to the use of cortisone in 1949, treatment included heat, massage, steam cabinet baths, diathermy, counterirritant ointments locally, infrared radiation, etc.

At a conference on steroids at the New York Academy of Sciences in December, 1958, Doctor Russell L. Cecil stated: "Doctor Hench made the point a year ago that the really big field for these corticosteroids is in acute conditions. And I too think we ought to put more emphasis on treatment with steroids in such acute rheumatic conditions as bursitis, fibrositis, myositis — all fairly prevalent muscular conditions that people get. I would like to make the point that not enough attention is being given to the use of these drugs in the prevalent, everyday garden variety of acute and subacute rheumatic conditions. These are much more common than rheumatoid arthritis."

Rosenberg[1] reported that some patients had experienced outstanding improvement following the use of cortisone. Olson[2] reported beneficial effects in patients on hydrocortisone. We[3,4] found the newer corticoids to be useful in such disorders.

In treating severe allergies with Gammacorten for an average period of 26 weeks, Parish[5] noted that, "Despite the fairly long duration of administration, none of the more serious side effects which are encountered occasionally dur-

TABLE I.

AVERAGE DOSAGE SCHEDULE FOR GAMMACORTEN

Duration of Therapy	8 A.M.	Noon	4 P.M.	8 P.M.
1 to 2 days	0.75 mg.	0.75 mg.	0.75 mg.	0.75 mg.
2 to 3 days	0.75 mg.	0.75 mg.	—	0.75 mg.
Then	8 A.M.	2 P.M.		8 P.M.
2 days	0.75 mg.	0.37 mg.		0.37 mg.
3 days	0.37 mg.	0.37 mg.		0.37 mg.
7 days	0.37 mg.	—		0.37 mg.
7 days	0.37 mg.	—		—

ing steroid hormone therapy were seen in this series."

Acute periarticular inflammations often result in time lost from work. If trauma is involved, they can pose serious disability problems over a protracted period. If the initial treatment is effective, the period of disability is dramatically shortened. Therefore, it was decided to study the effect of the newest corticosteroid, Gammacorten, in combination with buffered salicylates.

Gammacorten is a glucocorticosteroid (dexamethasone) which has six times the antirheumatic activity of prednisolone[6] but with no significant sodium retention. Buffered salicylates, a combination of aspirin, aluminum glycinate, and magnesium carbonate, tend to eliminate gastric intolerance to the salicylates.[7,8]

A total of 54 patients suffering from bursitis, tenosynovitis, acute back strain, etc., were given short-term therapy with Gammacorten and buffered salicylates.

Table I shows the average dosage schedule employed, one Gammacorten tablet being 0.75 mg. Each tablet is scored; thus a half tablet can be given as the dosage is reduced gradually. The initial dosage is 0.75 mg. four times a day for two days. Then, depending on individual response, the dosage is reduced gradually every few days.

It is imperative not to stop steroid therapy suddenly. Gradual tapering, as indicated in the above table, eliminates the need for adrenocorticotropic hormone — ACTH — at the termination of treatment. In such a short period of time and with the small doses of Gammacorten used, the adrenal cortical atrophy which usually occurs in long-term therapy is not seen. Thus patients did not experience any withdrawal symptoms. This careful regulation of dosage has been proven eminently safe. We observed previously that in dosages of three to five grams daily, buffered salicylates enhanced the antirheumatic effect of the steroid. This was especially true with Gammacorten.

TABLE II.

Indication	Number of Patients	RESULTS Excellent	Fair	Poor
Acute Bursitis	7	7	—	—
Subacute Bursitis	6	4	2	—
Chronic Bursitis	20	16	3	1
Myositis	5	3	2	—
Acute Back Strain	2	2	—	—
Frozen Shoulder	8	7	1	—
Neuritis	3	—	2	1
Epicondylitis	3	3	—	—
	54	42	10	2

Results

The therapeutic results are tabulated in Table II below. Symptoms subsided rapidly, and relief of pain in one to two days was marked in most of the "excellent" results. Restriction of motion rapidly disappeared. Thus patients engaged in tasks requiring manual dexterity were able to return to their occupations more quickly with Gammacorten.

Side Effects

Under the following conditions: (1) short-term therapy, (2) the small doses of Gammacorten used, and (3) the careful, gradual reduction of dosage, no side effects or Cushingoid syndromes were observed. No symptoms of acute adrenal hypocortisonism or steroid pseudorheumatism were encountered when treatment was terminated. Thus these patients are ideal candidates for steroid therapy.

Summary

The most common indications for Gammacorten therapy are the acute rheumatic periarticular disorders, such as myositis, bursitis, tenosynovitis, etc. The use of buffered salicylates along with Gammacorten seems to enhance the antirheumatic effect. In this series of 54 cases, the majority of the 42 "excellent" results experienced relief of pain in one or two days. This plan of treatment shortened the period of disability from work.

Patients who had not responded to previous varied treatments, including salicylates, local block, and physical therapy, obtained relief with Gammacorten.

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Theories of the Causes of Silicosis—part I

• G. W. H. SCHEPERS, M.D., D.Sc.
Haskell Laboratory for Toxicology and Industrial Medicine
E. I. du Pont de Nemours and Company
Wilmington, Delaware

Presented at the McIntyre Research Foundation Conference on Silicosis and other Industrial Pulmonary Diseases, January 25-27, 1960, Toronto, Canada. This is the first of three installments.

Although silicosis remains a contentious subject, no assertion about this disease elicits greater general agreement than that an adequate theory of its pathogenesis remains extant. The biological action of the main industrially important siliceous dusts is well documented, but several mysteries defy explanation. Some of the apparent nescience about the causation of silicosis may be due to lack of appreciation of the available information which is widely dispersed in technical journals. Collation and critical analysis of recorded data may, therefore, serve a useful purpose. To this review interpretations based on personal experiences will be added.

An extraordinary number of attempted explanations of silicosis have been advanced. Several of these have so little relationship to well established facts as to merit no more than cursory mention. In Tables I to IV, 50 theories have been grouped under the four themes: exploratory, chemical, physical, and biological.

The diversification of these theories reflects the perspective of their authors, who range from pathologists, chemists, biologists, and engineers to armchair philosophers. These perspectives have been influenced also by the width of the spectrum of siliceous compounds (over 500 varieties), and the even greater array of minerals (over 3,000) with which siliceous minerals may be associated. No single authority commands first-hand information about all these factors. Many authors are seemingly acquainted with mere fragments of information. Among the over 7,000 published contributions on dust diseases occur both wheat and chaff. In some areas our knowledge remains sadly deficient. Consequently, though most of the manifestations of silicosis can be accounted for, it remains difficult to formulate an all embracive theory. No single published explanation is conclusive, but most modern theories contain some or other element worthy of further consideration.

Exploratory Concepts

The ambition to formulate theories is as old as human logic. Pneumoconiotic lesions have been found in Egyptian mummies, which is not at all surprising when one visualizes what dusty labor the building of the pyramids entailed. Some day a hieroglyphic account of silicosis may be discovered on some ancient papyrus or petroglyph. Even Stone Age man, shaping flints in small caves, may have exposed himself to the risk of contracting minor grades of silicosis, as happened many centuries later to the flint knappers. Fleeting references to occupational chest ailments, attributed to polluted air, are scattered through Greek and Roman manuscripts from the days of Aristotle onward. It is possible that interest in this group of diseases did not originally command sympathetic emphasis since mining and rock breaking were hazardous tasks reserved for slaves, prisoners, and condemned men. The first lucid references to these diseases occur in the writings of Agricola (1556), Paracelsus (1567), and other less well known 16th and 17th century physicians. Among these reports, the book of Diemerbroeck (1672)

TABLE I.
EXPLORATORY CONCEPTS OF SILICOSIS

Theory	Author	Year
Polluted Air	Aristotle	300 B.C.
Dust	Agricola	1556
Mining	Paracelsus	1567
Rock Breaking	Diemerbroeck	1672
Dusty Trades	Ramazzini	1700
Miner's Phthisis	Miscellaneous	18th Century
Inhaled Particulates	Pearson	1813
Melanosis	Laennec	1819
Silica	Thackrah	1831
Endogenous Pigment	Virchow	1847
Silica Dust	Zenker	1866

is outstanding in that the first accurate description of silicotic lungs, with demonstration of their mineral content, occurs here. Ramazzini (1700) further prospered the understanding of silicosis by noting its occurrence not only in miners but also in other industrial workers.

During the greater part of the 18th century the relationship of silicosis to tuberculosis became apparent. Soon the two diseases were confused, and many cases of silicosis were diagnosed as variants of tuberculous phthisis. After the discovery of the Koch's bacillus with sequential acceptance of the concept of transmission of tuberculosis by bacillus-laden fomites, it was natural that the concept "miner's phthisis" should have arisen. There were no means to refute that infection with tubercle bacilli was the principal factor in the development of every silicotic lesion as long as the majority of silicotics continued to die of overt pulmonary tuberculosis.

Understanding of silicosis made slow progress during the 19th century, but it is worth noting that Pearson (1813) had focussed attention on the role of particulate matter in the genesis of this disease. Then there was some backsliding. It is salutory to note that no less famous a physician than Laennec (1819) was completely misled by the carbonaceous pigmentation of the silicotic lung and interpreted the condition as an exaggerated melanosis. To the astute Thackrah (1831) goes the credit for first identifying silica with the occupational disease of miners, though it remained for Zenker (1866) to suggest the nomenclature of "silicosis." Meanwhile, one of the greatest pathologists, Virchow (1847), was completely fooled by the evidence available to him. His interpretation of silicosis as a manifestation of endogenous pulmonary pigmentation is, of course, completely erroneous. However, like so many other fallacies, this concept included an element of truth. Today it is becoming more and more evident that intrinsic rearrangement of pulmonary mineral components, no matter whether endogenous or exogenous, also is a factor in silicosis.

TABLE II.
SILICOSIS
CHEMICAL CONCEPTS

Theory	Author	Year
Chemical Interaction With Tissue	Aldridge	1892
Silicic Acid	Haldane	1914
Solubility	Mellor	1918
Colloidal Silica	Gye	1922
Amorphous Surface Layer	Carleton	1924
Uncombined Silica	Gardner	1926
Sericite	Jones	1933
Trapped CO_2	Edge	1934
Alkalinity	Briscoe	1937
Acidity	Holzapfel	1942
Unsaturated Valencies	Weyl	1950
Polymeric Silica	Holt	1956
Mineral Shifts	Schepers	1960

TABLE III.
SILICOSIS
PHYSICAL CONCEPTS

Theory	Author	Year
Angularity	Zenker	1866
Fresh Fracturing	Heffernan	1935
Piezo-electric Forces	Velicogna	1946
Negative Charge	Hounam	1952
Crystallinity	King	1953
Critical Particle Size	King	1953
Submicron Particles	Jötten	1953
Critical Surface Area	Dworski	1955
Surface Adsorption	Iler	1955
Protein Adsorption	Schepers	1960
Electrophoretic Mobility	Schepers	1960
Heat of Wetting	Schepers	1960

Chemical Theories

The chemical nature of silicosis appears to have been suggested first by Aldridge (1892). The mystery of the matter is that this concept was not popularized sooner, since siliceous dusts are all chemical compounds and the body tissues are composed of organic chemicals.

The solubilization of quartz to form silicic acid attracted the attention of Haldane (1914) and Mellor (1918) and initiated 40 years of theorization around the roll of silicic acid in the genesis of silicotic tissue. This information fitted in well with Haldane's discovery of the antidotal action of certain dusts, an observation

TABLE IV.
SILICOSIS
BIOLOGICAL CONCEPTS

Theory	Author	Year
Tuberculogenic	Watkins-Pitchford	1914
Phagocytosis	Mavrogordato	1922
Solubilization *In Vivo*	Policard	1933
Fibroblast Proliferation	Wolbach	1933
Lymphatic	Strachan	1934
Phospholipid	Fallon	1937
Silica Shock	Modell	1941
Ischemia	Cole	1948
Protein Denaturation	Jäger	1950
Collagenosis	Gough	1952
Hypersensitivity	Scheel	1954
Auto-immunity	Vigliani	1956
Enzyme Destruction	King	1957
Polysaccharide-Polysaccharase Imbalance	Holt	1959
Necrobiogenic	Schepers	1960

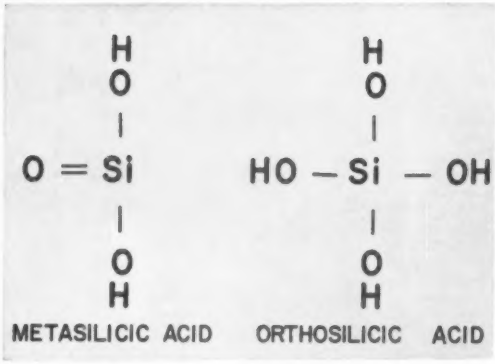

Figure 1

which seemed readily explicable in terms of chemistry.

Silica solubility is an immensely interesting and tremendously important industrial factor. The chemistry of silicic acid occupies volumes. Expressed in its simplest form, however, metasilicic acid and orthosilicic acid (Figure 1) are realities, although there is some evidence that in their formation the coordination number of silica has to be increased transiently from four to six, especially in alkaline solutions (Weyl).

The solubility theory gathered considerable impetus from the demonstration by Gye and Purdy (1922) that injected colloidal silica can induce hepatic necrosis in mice. This strongly suggested that colloidal silicic may be liberated from inhaled silica particles brought into contact with tissue fluids. In this way the silicic acid was presumed capable of directly poisoning the cellular structures of the lung. The work of Kettle (1926) also contributed magnificently to this theory. By implanting a silica filled collodion bag in the flank of a rabbit, an inflammatory reaction was provoked. Such a response did not follow when the collodion sac contained no silica. This appeared to prove rather conclusively that a soluble form of silica, which had transpermeated the collodion membrane, is pathogenic for living tissues. Kettle also demonstrated that quartz particles, which had been coated by iron oxide, were incapable of exciting tissue reactions similar to those induced by uncoated silica. This was interpreted as signifying that desolubilization of silica by the ferric oxide had prevented the development of the silicotic reaction. Further support along these lines came with the discovery by Denny, Robson and Irwin (1934) that the pathogenic action of quartz dust can be completely suppressed by coating the particles with aluminum monohydrate. They showed a rather precise correlation between the reduced solubility of the aluminum coated quartz particles and the inhibition of silicosis (Table V). This generated interest in correlation studies between the solubility of mineral dusts and their pathogenicity. Briscoe, et al. (1936) demonstrated that asbestos, flint, and quartz, which are highly injurious to the lungs, also are appreciably more soluble in water than are relatively inert substances such as feldspar, sericite or kaolin. Results of a similar nature were produced by King and Belt (1938). It seemed particularly significant that these more soluble siliceous compounds are more pathogenic than those which are less soluble.

As with much else, beauty is in the eye of the beholder. The solubility theory crumbles in many respects as soon as it is critically analyzed. Thus, it may be noted that much of the solubilization work was done at 100° C. in the petrographer's laboratory. The results thus obtained were, perhaps, compared with too great alacrity with the biological actions of the corresponding minerals. Solubility at body temperature in fluids more closely similar to body fluids would seem more appropriate.

Determined in this manner, silica solubility does show certain correlations with pathogenicity. Thus, Schepers (1960) in a recently completed survey of 14 varieties of particulate silica reveals a well defined relationship between the solubility in distilled water at 37° C. over a period of 48 hours and the biological potency of these dusts (Figure 2). This does not, however, prove that solubility is the causal factor. There is evidence even to the contrary. Thus, sandstone is poorly soluble yet highly fibrogenic. Gardner (1925) also showed that when injected intravenously or intracardially in experimental animals silicic acid appears to exert no harmful action. The range and significance of solubility has been extensively explored by King and coworkers (1956). Most recently it has been shown that the presence of silicic acid (10-20 γ/cc) in tissue cultures has no influence on the growth of lung and spleen cells (Knake, et al., 1959).

TABLE V.
INFLUENCE OF ALUMINUM ON SOLUBILITY OF SILICA

SiO_2 Source 1 gm —325 Mesh	Relative Pathogenicity %	SiO_2 Dissolved 20 hrs/37° C Without Al. ppm	With Al. ppm
McIntyre	80	27.1	1.9
Montreal	40	3.8	0.5
Kolar	20	28.0	1.8
Rand	100	8.8	1.8
Chert	50	22.1	8.0
Flint	100	147.0	3.4
Asbestos	100	21.2	0.8
Serpentine	30	10.0	0.9
Talc	0	64.0	1.0
Sericite	0	40.7	0.9
Kaolin	0	6.2	0.7
Granite	30	6.4-7.7	0.7-1.0

After Denny, Robson and Irwin, 1937.

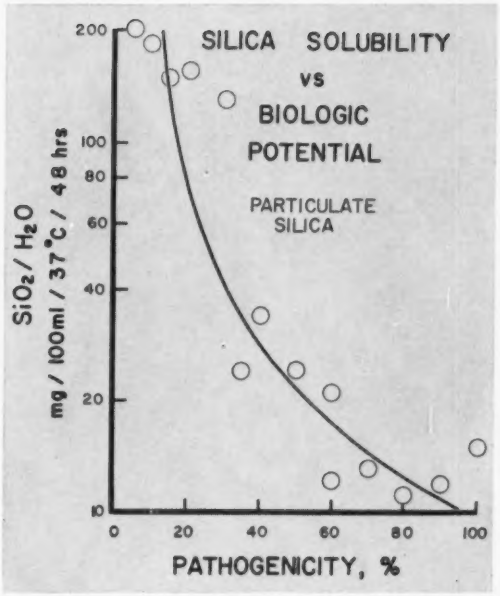

Figure 2

Light has recently been shed on the meaning of the solubility of silica. By meticulous studies, Nagelschmidt, Gordon and Griffin (1952), Holt and Osborne (1953), Jäger (1953), Scheel (1953, 1954, 1955) and Lucas (1958) have proved that when particulate quartz is steeped in watery solutions a highly soluble outer layer is dissolved off. Therefore, very little solubilization takes. These discoveries relate to Carleton's (1954) suggestion that the quartz crystal is covered by an amorphous silica layer and that this is the source of the pathogenicity. Carleton's suggestion is related to the demonstration of this disturbed surface layer by electron diffractrometry. Gibb (1953) found that it varied in depth from 30 to 60 millimicrons. Dempster and Ritchie (1953) had previously suggested that the thickness of this layer may range to 150 millimicrons and had showed that it can be etched off by hydrofluoric acid. The residual quartz crystal, which will yield no further silicic acid, has lost none of its fibrogenicity. This leaves intact the suggestion there there is an amorphous layer which is soluble but indicates that it may be the nonsoluble part of the quartz crystal which injures tissues. According to Iler (1955), the solubility of micronized quartz can be directly calculated in terms of the formula $\frac{\text{Ln } Sr}{S} = \frac{2EV}{RTr}$ in which **E** is the surface energy (ergs/Cm^2); **S**, the solubility of large particles; **Sr**, the solubility of small particles of radius **r**; **V**, the molar volume (cc), **R**, the gas constant (8.31×10^7 erg/mole/degree) and **T**, the absolute temperature. The resultant calculation has been expressed in the graph of Figure 3. If the solubility of quartz governed entirely its pathogenicity, there should be a precise correlation between the degree of micronization of quartz particles and their biological action. Critical studies to prove this point with respect to quartz dust yet requires to be done. There is, however, supporting information from studies with amorphous silica. In terms of the foregoing formula, V is 29cc and E probably 133 ergs/cm^2. This enables calculation of solubility/particle size ratios as represented in Figure 4. Available personal studies of 10 varieties of amorphous silica of different particle size shows that the theoretical calculation is entirely valid. This lends credence to the view that solubility is a function of particle size for silica, no matter whether of the amorphous or crystalline variety.

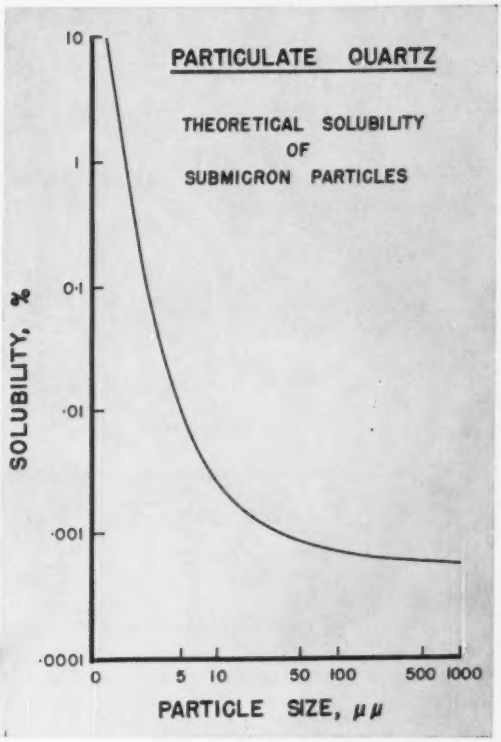

Figure 3

Gardner's extensive experimental studies on silicosis brought to light that the pathogenic compounds of silicon are mostly crystalline and generally occurred as uncombined silicon dioxide. This strongly influenced the views of experts in this field and gave rise to the concept that silicosis can only arise if the offending silica is crystalline. It has been established, however, that although it is generally true that free crystalline silica is more pathogenic than silicate

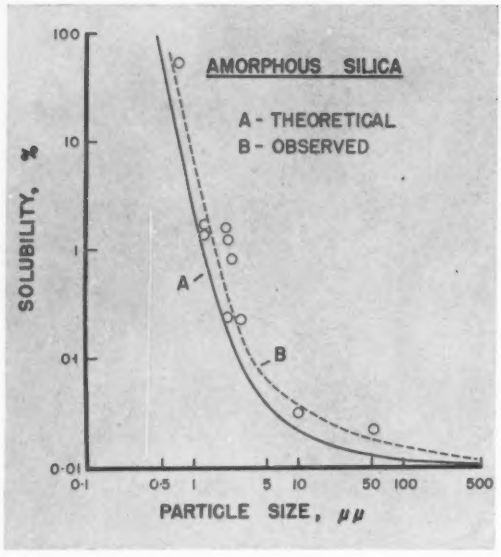

Figure 4

compounds, the reverse holds true for certain varieties. Thus, amosite (ferrous magnesium aluminum silicate) tremolite (calcium magnesium fluorosilicate) and crysotile (hydrous magnesium silicate) are classical examples of combined silica which are highly injurious to pulmonary tissue. Opal and vitreous silica again are noncrystalline yet definitely pathogenic. Most of the synthetic submicron silicas are amorphous though uncombined. Some are inert, some fibrogenic, and some toxic.

Since the solubilization of quartz appeared not to be a flawless theory of the causation of silicosis, further speculation about pathogenic chemical factors were in order. The introduction of Jones' (1933) sericite theory caused a flurry of excitement. The sericite theory was introduced in an attempt to account for the low incidence of silicosis in the Kolar gold field as compared with the calamitous prevalence of this disease in the South African and Australian gold mines. Since quartz was present in equally high concentrations in the first two rock systems, while the sericite concentration was low in the Kolar field, but high in the South African and Australian quartzite beds, sericite appeared to be the common denominator. Its potential role in silicosis was further implied by the demonstration of sericite in silicotic tissue and the knowledge that sericite bonds together quartz crystals.

The intrinsic pathogenicity of sericite was promptly disproved by Policard (1933), King and Irwin (1934), Lemon and Higgins (1935) and Fallon and Banting (1935) who failed to produce a significant pneumoconiotic reaction in

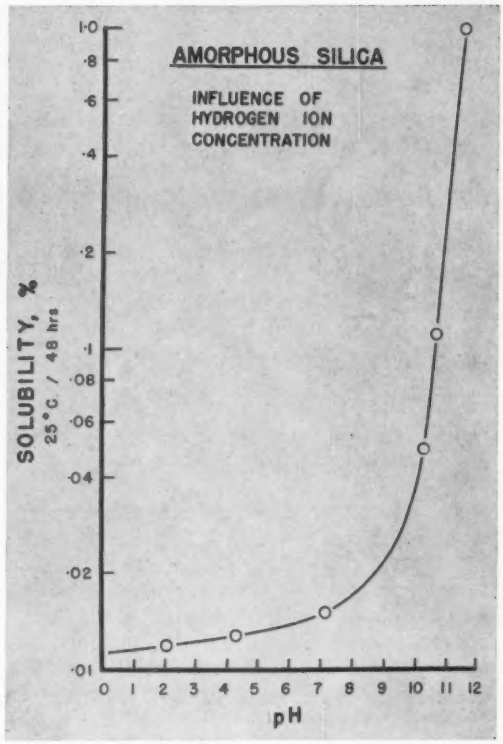

Figure 5

experimental animals which had received sericite by antratracheal injection. Moreover, it had already been clearly established that classical silicosis could be induced in experimental animals through the inhalation of pure quartz dust. We know, too, that the discrepancy between the biological effect of Kolar quartzite and Rand quartzite does not depend on the enhanced sericite in the latter, but is due to the high aluminum content of the former (Ffrench, 1955).

A year after the sericite theory was formulated, Edge (1934) proposed an interesting explanation for silicosis. It has long been known that even the purest quartz contains several nonsiliceous ingredients. One of these is liquid carbon dioxide. Edge suggested that when quartz particles dissolve in pulmonary tissue, the carbon dioxide microinclusions may explode with a disruptive force about half a ton per square inch. This is an impressive thought. It is as difficult to prove this theory as to disprove it. Perhaps, the fact that some of the synthetic submicron amorphous silica dusts are highly pathogenic, although entirely free from carbon dioxide impurities, is sufficient contrary evidence. It is also known today that quartz may contain other impurities such as mercury and, quite inexplicably, mineral oil.

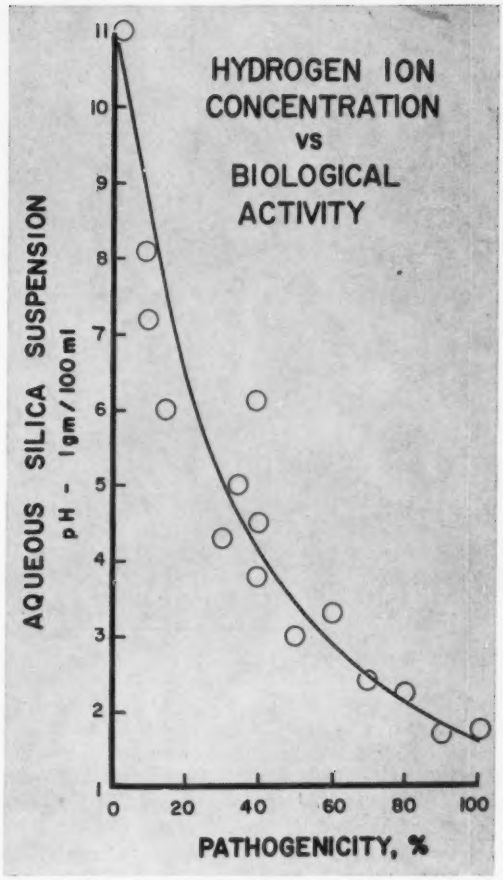

Figure 6

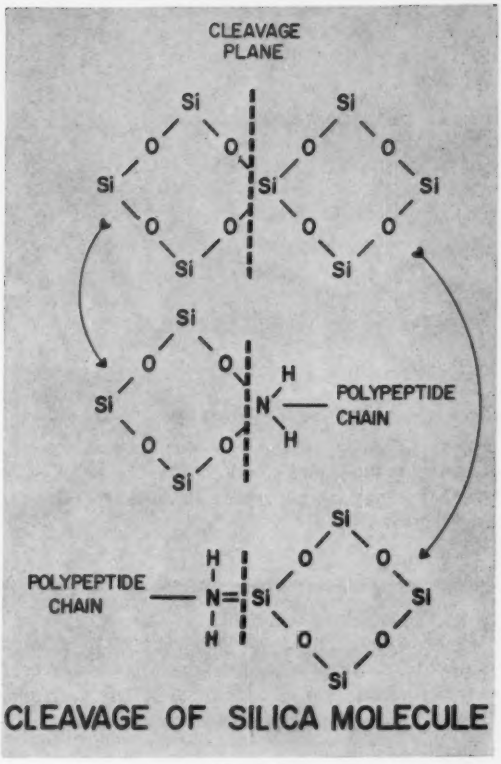

Figure 7

Another variant of the impurity theory was suggested by Briscoe (1936), who noted that most pathogenic rocks are alkaline. This postulate was fortified by adverse experiences with alkaline siliceous scouring powders and the harmful effects of soda ash when added to s ous ceramic ingredients. This observation of Briscoe together with subsequently garnered data brought to light that the *in vitro* solubility of quartz is decisively influenced by the pH of the solution (Denny, Robson and Irwin, 1937). A similar principle applies for amorphous silica. There also is a correlation between solubility and the hydrogen ion concentration of the silica suspension at the end of 48 hours at room temperature. This was confirmed by a recent survey (Schepers, 1960) of the properties of amorphous silica. Examples were available with a pH range of 2 to 11. Those silicas with the lowest pH (Figure 5) were least soluble, whereas solubility increased sharply as the pH rose.

An almost diametrically opposite theory of the silicogenic action of quartz was suggested by Holzapfel (1942, 1949), who was much more impressed by the possibility that the acidity of silicic acid is a potential factor in pathogenesis. According to Holzapfel, the acidic nature of silicic acid is necessary to enable the participation of $Si(OH)_4$ in base exchange and ester saponification in tissues. In this connection it may be of relevance to mention that the addition to quartz dust of either potassium carbonate (Schepers, 1955) or of gypsum (Schepers, Durkan, and Delahant, 1955) elevates the pH and effectively nullifies the pathogenic action of the silica. The hydrogen ion concentration, therefore, specifically influences the pathogenicity of several types of silica. In Figure 6 an inverse correlation between pH and pathogenicity is demonstrable for 15 varieties of silica (Schepers, 1960).

Two further chemical theories have appeared during recent years. The first is a hybrid between chemical and physical categories. Weyl (1950, 1951) suggested that quartz may be pathogenic because of unsatisfied oxygen and silicon valencies. This postulate is one variant of the theory of Haber (1914), that atoms forming the superficial layer of a particle can be only partly satisfied internally, leaving residual

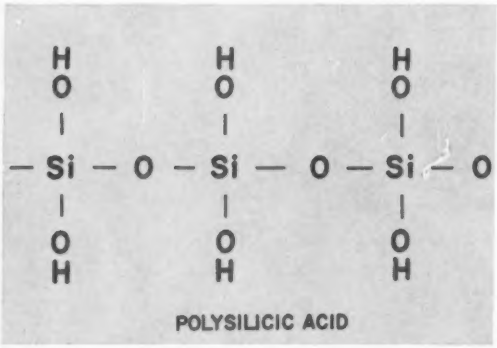

Figure 8

superficial valencies externally. The inherent forces involved in the adsorption of foreign atoms or molecules onto the surfaces of such particles may be expressed in terms of the following equation:

$$\frac{P}{x/m} = \frac{1}{ab} + \frac{P}{b}$$

(P = vapor pressure of adsorbate, x/m = amount of adsorbate per gram of adsorbent, a = constant, b = proportional to the maximum number of adsorbate molecules, which can be accommodated per unit area).

The unsatisfied valency theory can be summarized diagrammatically (Figure 7). In terms of Haber's law, the positively charged silicon valencies are likely to hydrate while the negatively charged monoxide valencies will tend to capture additional oxygen. Weyl, however, postulates that the surface of the quartz particle is repolarized in such a manner that the O_2 ions are at the surface, while the Si^+ ions are sheltered in deeper layers. In the diagram it has also been suggested that the Si^+ and O^- valencies may be satisfied by linkages with the polypeptide chains of living proteins.

The further chemical theory which gained considerable attention recently is a polymeric silica concept proposed by Holt (1957). The capacity of dissolved silica to lead to the formation of polysilicic chains of undelimited complexity is well known *in vitro* observation (Figure 8). Holt suggests that, whereas orthosilicic acid may be incapable of provoking silicotic fibrosis, though it may induce simple silica proteinate compounds, the side union of series of silicic acid molecules will facilitate locking together of protein molecules. By postulating that the reaction between the silicic acid and the protein can occur at multiple points, parallel binding of the protein molecules may be effected. Holt supposes that silicic acid may accumulate in tissues after prolonged residence of quartz

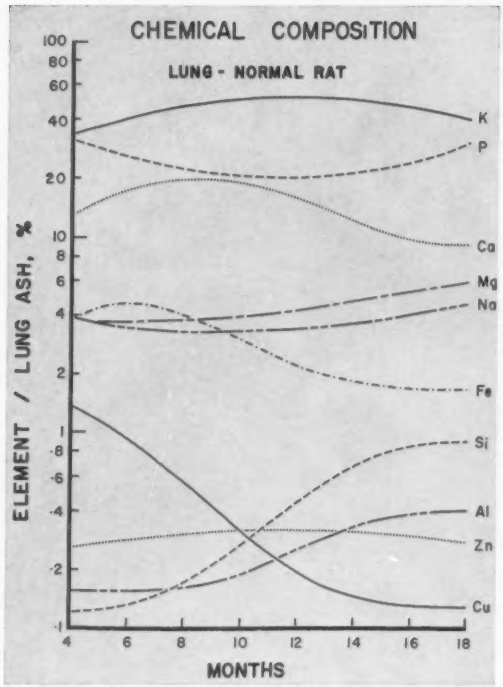

Figure 9

particles. Ultimately, the concentration becomes sufficient to form polymeric chains. This concept takes cognizance of the apparent latent period in the development of silicosis. Among the chemical theories, Holt's proposal is outstanding in that it reconciles a number of observed biological phenomena. It is, however, not yet adequate as an explanation for silicosis. Thus, it does not explain how silica proteinate becomes collagen. Second, it presupposes that quartz particles, once deposited in the lungs, remain in one fixed location. This they seldom do. Third, the polymeric concept would be fortified were it possible to demonstrate the presence of unusual quantities of polymeric silica in presilicotic or even in silicotic pulmonary tissue. Such a demonstration is lacking. Sakabe et al., (1956) suggested that this may occur, but a subsequent publication by Wheatly (1957) negates this. Moreover, it is already well documented that dissolved silica is eliminated from the body *via* the urinary and alimentary tracts almost as fast as it is released in the lungs. Finally, when silica particles become imbedded in tissues, there is an immediate and violent local response which precedes any possible formation of polysilicic acid.

The final chemical notion may be entertained at this point. If the actual combination of SiO_2 or of $Si(OH)_4$ with tissue is the essential feature

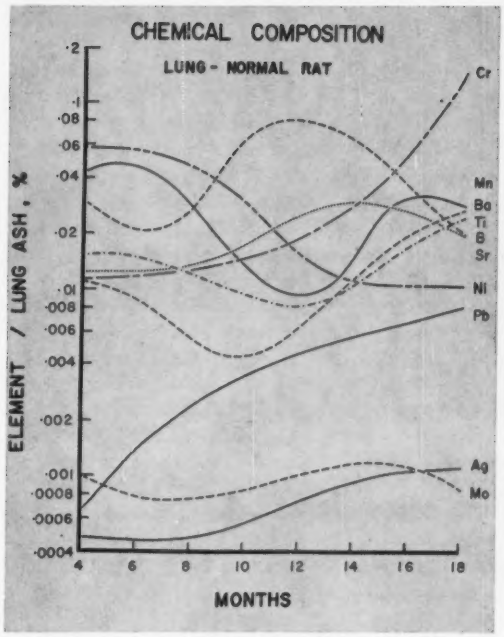

Figure 10

in silicosis, it is necessary to consider all the substances in the lung with which the silica can combine. The biochemical reactions with organic compounds will be considered in connection with biological theories. It may be pertinent, however, to point out under the heading of chemical theories, that the lung is the repository of a large number of mineral elements of both extrinsic and intrinsic origin. The relative concentrations of elements change with age (Figures 9 and 10). Systematic analyses for these elements in experimental and clinical subjects has brought to light that extensive shifts in the concentrations of various elements occur on exposure of the animal or person to quartz dusts (Schepers, 1960). Some increase, some decrease. In some instances it may be possible that chemical combinations occur causing the retention of selected elements. The loss of certain elements from the lung tissue may be equally relevant.

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TRAUMA and VASCULAR DISEASES ARISING from COLD INJURY

—Evaluation of Aggravation, Acceleration, Exacerbation, and Causal Relation

• HARRY E. TEBROCK, M.D.
Medical Director
Sylvania Electric Products, Inc.
New York, New York

• MARTIN M. FISHER, M.D.
Division I, Post-Graduate Unit
State University of New York
New York, New York

The majority of the diseases of circulation involve prolonged disability and care. In many cases there is loss of limb, and in a few, total permanent disability; particularly in the elderly where rehabilitation for prosthesis usually is of little avail.

An example of importance is that group of patients who are exposed to low environmental temperatures as the cause of unemployment. Within this syndrome we place many vascular disorders and call them all "cold-injured disabilities." This group includes the syndromes of trench foot, immersion foot, foxhole foot, frostbite, pernio, chilblain, and now the new high altitude frostbite with its associated gangrene of both hands following 30 second exposures. Others in this group are the cold sensitivities, Raynaud's phenomenon in Raynaud's syndrome, cutis marmorata, and cold allergies.

A study was made to evaluate the responsibility that industry feels for workers exposed to cold, and compared with the incidences noted during wartime, where maximum protection was not available. Letters were sent to medical directors of a number of prominent corporations whose workers are exposed to cold, and following are some of the responses. Those in charge of the Greenland contractors, a group of independent contractors operating near Thule, Greenland, reported the following findings: They dealt with as many as 1,200 construction employees each season and there were no cases reported of frostbite, frozen extremities, or gangrene.

Another report was an observation for two and one-half years of an electric company which had to maintain the Dew Line and the White Alice operations in Alaska and Northern Canada. During this period there was an average of 2,500 employees. Over this entire period they reported only one case of a peripheral vascular disease; this resulted from a plane crash and the pilot was exposed to low temperature for approximately 40 hours; this resulted in amputation of toes and fingers plus nose damage.

In the five year study of the maintenance workers on the outdoor electric poles throughout the New York area and in temperate climate, there was but one case of a direct injury to an ankle precipitating an arterial occlusion. This case responded well to a sympathectomy.

A leading telephone and telegraph company

advised us regarding their personnel in the frozen northern countries, those on the Dew Line, and those engaged in out of the country activities for Western Electric. They reported two cases of cold-injured extremities of engineers exposed to extreme cold after a forced landing in a plane accident with no residual complications from cold-injured exposure.

In the military, there were numerous problems of frostbite and immersion foot during World War II. One of us observed and treated some 1,500 cases of trench foot.

Dr. Henry Bakst reported to us that while stationed at a Naval base in Newfoundland, during World War II, he had numerous instances of vascular disorders from cold because of the frequency of ship sinkings in this area during the early part of the war and as a by-product of the climate itself. In civilian life he reported but one case, in which the person was exposed to temperature of 24° below zero for 36 hours with subsequent loss of many digits.

The Metropolitan Life Insurance Company was kind enough to supply us with statistics of cold injuries of civilian groups in Illinois and Wisconsin. *The Annual Report on Compensable Work Injuries in 1957* in Illinois, showed but 20 injuries due to cold weather. The industries in which the injured were engaged were manufacturing, two cases; wholesale trade, two cases; retail trade, seven cases; transportation and other utilities, five cases; and services, four cases.

Another report, entitled *Diseases of Occupations and Other Non-Accidental Injury Cases*, published by the Industrial Commission of Wisconsin, 1954, shows five disability cases assigned to freezing: one carpenter, one factory worker, and three in other occupations.

Statistics concerning cold injuries in the Army are shown in the monthly report *Health of the Army* published by the Office of the Surgeon General, United States Army. Comments made in January, 1958, are as follows: "The incidence rate for cold injuries occurring in peacetime occur almost exclusively during maneuvers. They decreased in the United States from 2.0 per 1,000 in December (the highest rate since February, 1955) to 0.2 in January, 1958. The overseas rate increased from 0.6 per 1,000 in December, 1957, to 2.1 in January, 1958, primarily due to the number of cases reported from Korea. The incidence rate in Korea increased from 2.2 in December, 1957, to 12.7 in January, 1958, (this was the highest rate for that area since February, 1952, which was a war year)."

Thus, we see that the incidence of cold-injured extremities is low in those industries today that share and assume the increasing responsibility for the protection and the care of the injured worker, as compared to that of the military. And during wartime and maneuvers the incidence increases six fold or greater. We have seen this syndrome of cold-injured extremity in civilian life in electric linemen, jet pilots, refrigerator repairmen in contact with freon; butchers exposed to freezing compartments, and outdoor employees such as gasoline attendants, traffic policemen, seamen, truck drivers, and laborers with prolonged exposure to cold.

The following syndromes we have classified as cold-injured extremity: (1) Frostbite ordinarily is a condition resulting from prolonged exposure to freezing or below freezing temperatures. Aside from the cold, duration of exposure and wind velocity also determine the severity of the frostbite. Other factors are individual susceptibility to cold, such as poor state of nutrition and old age with pre-existing asymptomatic impaired arterial circulation. (2) Immersion foot is exposure to dampness and cold, while trench foot is exposure to cold and dampness as well as fear of death. In both instances, immobility of the limb is present. (3) High altitude frostbite results in extreme damage with gangrene of the extremities, particularly of the hand owing to exposure to the cold at high altitudes. The degree of cold exposure varies from minus 40° to minus 61.6° F. The exposure is usually only a few minutes at the maximum and rarely involves parts of the body other than the hands as these pilots are usually well protected. (4) Chilblain or pernio is another clinical entity resulting from cold injury characterized by blotchy changes in the skin and cutis marmorata (marble skin); this is associated with itching, burning, erythema, rarely blebs in the late stages, and more rarely chronic ulceration of the skin; it is rare in the United States. In England, we could not help but notice the ruddy complexions of the women's cheeks and the blotchy mottlings of their legs. This has been attributed to the absence of central heating or heaters in public vehicles. The main factor in production of acute chilblains is exposure of the limb to cold and dampness; this, followed by sudden warmth such as placing the cold feet on a radiator or over a hot stove or near a fireplace, produces a sequence of events characterized by severe spasm with pain, then injury to the cutaneous vessels, producing a toxic erythema and finally permanent mottling. Only certain susceptible individuals react to such situations and they usually are young women at puberty or those in ill health, debilitation, or who live sedentary existences.

In all vasospastic conditions following exposure to cold the intensity depends upon the

exposure and the individual's susceptibility. In all the syndromes of cold injury, there are essentially no pathologic differences.

Trench foot of World War I is identical with immersion foot and shelter foot of World War II. Shelter foot was caused by spending evenings in cold air raid shelters while immersion foot was found in survivors of shipwrecks who were compelled to sit crowded in rafts for many hours with wet feet, dependent and immobile. Immersion foot was complicated by malnutrition and lowered general vitality. It must be borne in mind that in trench foot or foxhole foot, these patients, while exposed to cold, were also under shellfire with fear of death introducing a sympathomimetic component.

Frostbite, another syndrome of the cold-injured extremity, is a painful swelling caused by prolonged chilling in a confined position; this may or may not be associated with physical exhaustion.

When feet are removed from the cold, they are first swollen, waxy-white in color, and then woody and numb with anesthesia.

Prognosis, Disability and Causal Relation

Cold-injured extremities usually produce a permanent disability. This is self-evident when there is gangrene or indolent ulcer or permanent discoloration of the skin. There usually is increased sensitivity to cold in subsequent winters with loss of time from work. This is due to the vascular spasm and the pain that ensues from it.

In those over 50 years of age, there usually is some measure of peripheral arteriosclerosis regardless of whether these patients were asymptomatic prior to the cold injury. Following it there usually occurs permanent vascular damage which is refractory to our present methods of treatment of peripheral vascular diseases.

Treatment

It is essential, in treating those exposed to considerable cold, that special care be given to protect them with proper clothing; this was adequately shown in our study with the larger corporations. Covering the feet with mineral oil each night, thorough washing each night, act as good prophylactic measures. Care of interdigital cracks and abrasions about the feet is important, as frostbite is more apt to occur in those with lesions. Hand protection should be mittens to allow easy movement. Beards should not be allowed to grow in cold weather as the moisture from expired air which freezes adds to the frostbite hazard of the face.

The treatment of frostbite as a vascular emergency is just as important as the closure of a main artery. Remove shoes and socks, avoid rubbing, allow naked foot to be exposed to room temperature 68° to 72°. Alcoholic beverages are helpful. With anoxia of high altitudes, frostbite, malnutrition or anemia, 100% oxygen by mask is helpful; it decreases the incidence of loss of limb. In second degree cases with marked edema, elevation of the extremities is helpful.

Pre-Existent Arterial Disease and Effects of Cold Injury; Evaluation of Aggravation

Prolonged exposure to cold by itself with normal blood vessels produces arterial spasm. This is followed by diminished circulation through the area supplied by these blood vessels. Pathologically, the blood vessels that previously had been diseased with arteriosclerosis are more sensitive to cold injury. This manifests itself by endothelial proliferation, thrombosis, and adventitial thickening. The vessel wall reacts similarly to other forms of trauma be it mechanical, thermoelectrical or degenerative. Thus, the decision of whether one is dealing with exposure arteritis, cold injury, arteriosclerosis, or, more rarely, thromboangiitis obliterans does not rest exclusively on the biopsy of the blood vessel, but rather on the clinical evaluation. These conditions conducive to injuries by cold carefully have been analyzed and evaluated so that we now can finally differentiate them. Thus, a person with arteriosclerosis of the peripheral arteries is now known to be extremely sensitive to cold with increasing tendency to spasm by cold; when formerly it was thought that "pipe-stem" arteries had no vasospastic factor, this is easily disproved by the increasing incidences of Raynaud's phenomenon that we notice during the wintertime in the elderly upon exposure to cold weather.

Because of the insidious course of the vascular obliteration in arteriosclerosis in many of the cases, in contrast to acute segmental occlusion (which type are amenable to blood vessel grafting when there is a run-off as seen by aortograph), it may be conceded that subjective symptoms become manifest only after exposure to cold, thus the patient really believes that the exposure to cold of his vascular disease was aggravated by the cold trauma. This brings up many serious and important criteria to be able to ascertain and evaluate aggravation of pre-existing organic or functional peripheral arterial disease by cold.

The following are the criteria that we have established to evaluate aggravation of peripheral arterial disease by cold: (1) There may be evidence of vascular occlusion in extremities other than the one exposed to cold. This indicates evidence of pre-existent disease. (2) Cold injured

toes or feet may become pale, cyanotic, or gangrenous, but the vascular occlusion case of the natural progression over the underlying disease by the arteriosclerosis or thromboangiitis obliterans continues to ascend to higher segments. This type of progressive arterial occlusion is difficult to conjure on a single exposure unless it was prolonged and intense. (3) Evidence of other vascular involvement such as coronary, cerebral, or mesenteric are also difficult to explain on a single cold injury exposure. (4) The mechanism of aggravation from cold is the production of small to large blood vessel spasm, injury to collaterals, and the production of thrombi in minute vessels that are vulnerable. These previously were maintained in the equilibrium of circulation at a static point and then vascular decompensation takes place in hyperkinemic manner which leads to gangrene. This should result more readily than by the natural course of the disease. This should take place by producing symptoms and signs immediately or up to three weeks for causal relation to be established. Likewise, there should be an alteration in the previous course of the syndrome or disease to be causally related.

The following are our criteria for the symptoms and signs to consider in cold injury as an aggravating factor to pre-existent peripheral vascular disease: (1) The onset of pain in the leg, foot, or hand for the first time not controlled by rest, sedatives, and vasodilators. (2) Reactivation of leg, foot, or hand pain after a long quiescent period. (3) Abrupt decrease in tolerance for physical activity in a patient previously stabilized to his intermittent claudication with resultant diminution in walking distance. (4) Increased severity and frequency of rest pain (usually at night, in a patient lacking other vascular causes as a trigger factor to explain the worsening of the rest pain other than from the injury). (5) Radiation of rest pain or intermittent claudication to a new site such as back, thigh, knee, lateral aspect of knee, calf, or foot. (6) New features associated with pain such as excessive sweating, nausea, sense of impending gangrene with feeling of loss of limb, numbness, loss of toe motion and tingling; these all are ominous signs of impending arterial closure and pregangrene. (7) A new development of constant rest pain occurring in the early hours, or repeated nocturnal pain recurring during the same night, keeping the patient awake with loss of sleep. (8) Decreased relief of night pain offered previously by Chlor-Trimeton Repetabs 8 mg to 12 mg B.I.D., or Benadryl 50 mg B.I.D., each with or without 5 Gm of quinine sulfate at 6 P.M. and 10 P.M. These are the signs which characterize progressive peripheral vascular occlusion, with or without impending or threatened gangrene or ulceration. The alteration of a pattern of a previously clear picture of intermittent claudication is usually dramatic. This rests squarely on the accuracy of the report of the patient's history.

Summary

We have reported the relation of cold injury to peripheral vascular disease. We have classified many subgroups of cold injured extremities into one category for simplicity and ease of approach to therapy. We have attempted to give a working basis for the treatment of cold injured extremities. We have indicated that with the proper protective clothing, the incidence of cold injured extremities can be markedly diminished. We have presented working criteria to evaluate effects of cold injury as a factor in the aggravation of pre-existent peripheral vascular disease.

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Goniometric Study of the Human Foot in Standing and Walking

• PETER V. KARPOVICH, M.D.
Research Professor of Physiology
Springfield College
Springfield, Illinois

• LEIGHTON B. WILKLOW, M.S.

Since most industrial jobs require either standing or walking, the matter of foot comfort is one of the problems of industry. Strange as it may seem, our knowledge regarding the choice of proper footgear is still inadequate and often we buy shoes either on the strength of a persuasive advertisement or because we like the looks of them. In spite of some attention given by investigators during the last three decades to the foot and footgear, there is still a dearth of basic knowledge regarding foot action. One obstacle was a lack of simple, reliable methods for obtaining information not only during the static conditions of standing, but also during the dynamic conditions of walking.

This paper represents the results of an attempt to develop such a method. To simplify the task, only one aspect of the foot function was investigated, namely pronation and supination during standing and walking. A new instrument called an electrogoniometer was developed for this study.

Since a previous investigation had shown that the extent of pronation and supination can be found by measuring the angle formed by the lower leg and the calcaneus, Angle C, Figure 1, this angle was used in this study.

This report consists of two parts. The first deals with the foot in standing and the second with the foot in walking. In the first part, the foot in standing, angle C was measured in order to determine: (1) the effect of functional insoles as compared with conventional insoles; (2) the effect of distance between the feet; (3) the effect of body weight distribution; (4) the effect of heel height; and (5) the validity of the manual goniometer for measuring angle C. In the second part, the foot in walking, angle C was automatically measured and recorded by a new device called an electrogoniometer.

The Foot in Standing
Materials and Methods

The subjects were college students with normal feet.

Leg marking is illustrated in Figure 2. The subject stood with feet parallel to each other. The medial condyle of the tibia and the head of the fibula were found. Using sliding calipers, the midpopliteal point was found. A T-square was then placed horizontally at the lowest point of the medial maleolus and a mark was made on the middle of the tendon of Achilles, the mid-Achilles mark. To assure the horizontality of the square, a round spirit level was attached to this device (Figure 2, I). A line extending to the base of the heel was drawn through these points. Two more marks also were made: the midheel, one inch above the ground, and the talocalcaneal, midway between the mid-Achilles and the midheel.

An inclinator, an apparatus for changing the degree of pronation or supination in a standing subject, was used. It consists of two platforms hinged together in the middle, a jack under the hinge, and a protractor. By operating the jack, the middle may be lowered or raised, changing the angle formed by the platforms.

The portable platform (Figure 2, II) had two metal rods which could slide sideways and were

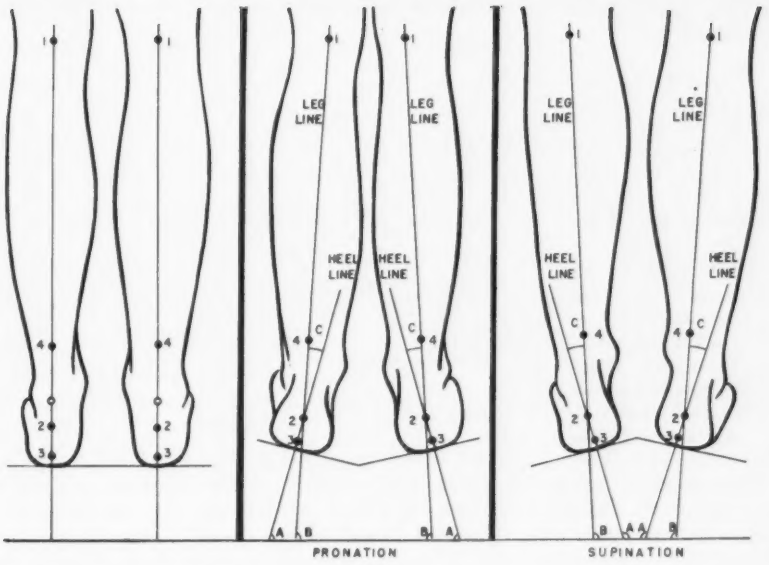

Figure 1

Skin marks on the leg, and angle C. (1) Midpopliteal points. (2) Midtalocalcaneal points. (3) Midheel points. (4) Upper Achilles points. In pronation C- B- A, in supination C- A- B.

used to keep the feet parallel, and toe plates which could slide anteroposteriorly and serve as stops for the big toes. A straight ruler was attached to the middle of the platform and served as an indicator of the verticality.

As in previous study,[1] legs of the subject were appropriately marked and photographed. The angle C was measured on these photographs.

Footgear had been made with transparent plastic uppers so that the markings on the skin could be photographed. Low quarter shoes and combat army boots with standard outsoles and also with Hack ripple outsoles were used. One half of each type of footgear had conventional insoles and the other half had functional insoles. A functional insole was made from a conventional one by placing inside the shoe a wedge-like, plastic insert over the medial half of the heel. There were, therefore, altogether six subtypes of footgear, loaned for this study by the Quartermaster Research and Engineering Center, Natick, Mass.:

1. Low quarter, conventional insole (LQc)
2. Low quarter, functional insole (LQf)
3. Boots, standard outsole, convention al insole (Sc)
4. Boots, standard outsole, functional insole (Sf)
5. Boots, Hack outsole,* conventional insole (Hc)
6. Boots, Hack outsole, functional insole (Hf)

The manual goniometer (Figure 3) designed for this study was made of transparent plastic. It consisted of two shafts and a protractor. The operator placed this instrument on the back of the subject's leg so that the longer shaft was on the leg line, the shorter shaft on the heel line, and the center of the protractor on the talocalcaneal joint (Figure 2, III). The operator read angle C directly from the protractor. Above the protractor there was a free-swinging indicator showing the degree of deviation of the long shaft from the plumb line.

*Hack outsole, ripple outsole, and ripple sole are synonymous.

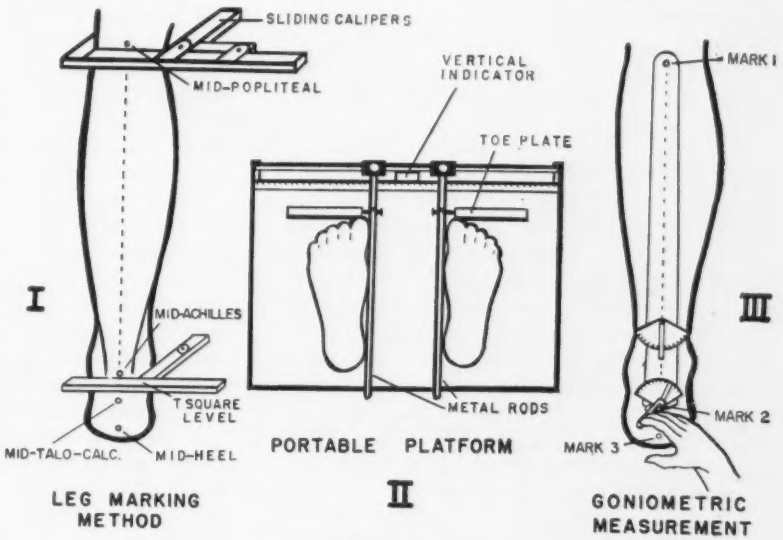

Figure 2

Leg marking method, portable platform and manual goniometer.

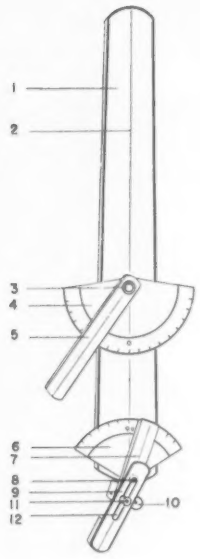

Figure 3
Manual goniometer. (1) Long shaft. (2) Center line. (3) Ball bearing. (4) Protractor. (5) Verticality indicator. (6) Protractor. (7) Angle C indicator. (8) Swivel joint. (9) Adjustable arm. (10 and 11) Winged screws. (12) Slot for adjustable arm. The long shaft is 16 inches long, three-quarters inches wide at the upper end, and one and one-quarter inches at the lower end. The protractor is three inches in diameter.

TABLE I.
The means of angle C for both feet of nine subjects standing on two separate planes inclined toward the middle line at 0°, 5°, 10°, 15°, and 20°

Footgear	0°	5°	10°	15°	20°	Grand Mean
Low quarter shoes, conventional insoles (L Qc)	4.9	—4.1	—9.3	—12.1	—14.6	—10.0
Low quarter shoes, functional insoles (L Qf)	6.2	—5.2	—9.2	—12.4	—14.9	—10.4
Boots, standard outsole, conventional insoles (Sc)	5.4	—3.9	—6.9	—8.8	—10.1	—7.6
Boots, standard outsole, functional insoles (Sf)	6.3	—3.7	—6.0	—9.0	—10.7	—7.4
Boots, Hack outsole, conventional insoles (Hc)	6.0	—3.9	—7.2	—9.2	—11.7	—8.0
Boots, Hack outsole, functional insoles (Hf)	6.4	—4.2	—6.8	—9.5	—11.7	—8.0
Barefoot	1.9	—3.0	—5.8	—7.5	—8.8	—6.3

Negative sign indicates pronation.

Three-way analysis of variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Squares	F
Subjects	8	345.75	43.27	13.1*
Inclination	4	11389.46	2847.36	862.83*
Footgear	6	304.64	50.74	15.38*
Footgear × subjects	48	308.62	6.42	1.94
Subjects × inclination	32	795.95	24.87	7.50*
Inclination × footgear	24	404.24	16.84	5.1*
Error	192	637.26	3.3	
Total	314	14185.92		

*Significant at the 1% level.

Results of the Duncan multiple range test of means given in Table I

Type of footgear	Barefoot	L Qc	L Qf	Sc	Sf	Hc	Hf
Mean degree of angle C	—6.3	—10.0	—10.4	—7.5	—7.4	—8.0	—8.0

Note: Any two means *not* underscored by the same line are significantly different from each other at the 1% level.

TABLE II.
Effects of distance between the feet on degrees of angle C in 12 barefoot subjects

	Distance between the feet		
	6 inches	10 inches	14 inches
Mean for subjects	—2.3°	.3°	1.5°

Negative sign indicates pronation.

Two-way analysis of variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Between subjects	11	295.42	26.86	4.16*
Between conditions	5	186.52	37.30	5.78*
Error	55	354.78	6.45	
Total	71	836.72		

*Significant at the 1% level.

Results

Comparison of the supinating effect of conventional and functional insoles. The subject stood on the inclinator so that each foot was supported by a separate plane inclined toward the middle line, forming a letter V, thus forcing pronation of the feet. The angles formed by these planes with the horizontal were equal and set at 0, 5°, 10°, 15°, and 20°. Nine subjects were used, barefoot and wearing the six subtypes of footgear.

The photographic method of recording and measuring angle C was used. The data and the results of the three-way analysis of variance are given in Table I. The differences between means or angles C obtained with subjects wearing footgear or barefoot were statistically significant at the 1% level, indicating that all tested footgear had a definite supinating effect. The difference between means obtained with conventional and functional insoles (.9°) was not statistically significant.

When the Duncan multiple range test was applied to the values of angle C obtained with the inclined planes, it was found that while the difference in angle C between the different types of footgear was significant, there was no difference in the effects of conventional and functional insoles for the same type of footgear.

Effect of distance between the feet upon angle C, barefoot. Subjects stood on a horizontal plane with feet parallel to each other and six, 10, and 14 inches apart (Figure 2). The purpose of this experiment was to determine the importance of the distance between the feet for diagnostic examination of the patient. Twelve subjects were used. A photographic method of measuring angle C was used.

Table II clearly shows that the distance between the feet affected the angle C. With feet six inches apart, there was an average pronation of 2.3°. With 10 inches between the feet, the average angle C was .3°, indicating a shift to supination; and only five out of 12 subjects

TABLE III.
Effect of body weight distribution on degrees of angle C in barefoot subjects

	Feet 6 inches apart						Feet 10 inches apart						Feet 14 inches apart					
	BODY WEIGHT DISTRIBUTION																	
	Wt. L*		Wt. E		Wt. R		Wt. L		Wt. E		Wt. R		Wt. L		Wt. E		Wt. R	
	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R	L	R
Mean	−3.4	.1	−1.8	−2.6	.4	−1.9	−.6	2.0	.9	.2	2.9	−3.1	−.4	3.2	.7	2.2	6.1	−.2
M $\frac{L+R}{2}$	1.7		−2.2		−.8		.7		.6		−.1		1.4		1.5		3.0	

*Wt. L—body weight shifted over left foot; Wt. E—weight distributed evenly over both feet; Wt. R—weight shifted over right foot.

L—left foot; R—right foot; $\frac{L+R}{2}$ = the average of angle C obtained from left and right feet.

Negative sign indicates pronation.

Four-way analysis of variance

Source of Variation	Degrees of Freedom	Sum of Squares	Mean Square	F
Main effects				
Distance	2	256.34	128.17	18.41**
Weight	2	11.49	5.74	.82
Subjects	6	544.05	97.34	13.98**
Foot	1	9.45	9.45	1.36
First order interaction				
Distance × weight	4	29.64	7.41	1.06
Distance × subjects	12	89.91	7.49	1.08
Subjects × weight	12	64.35	5.36	.77
Subjects × foot	6	333.07	55.51	7.98**
Distance × foot	2	11.29	5.44	.78
Weight × foot	2	349.19	274.58	39.3**
Combined second and third order interactions	76			
Error		528.80	6.96	

**Significant at the 1% level.

exhibited pronation. With 14 inches, the angle increased to 1.5°. The distance of 10 inches between the feet is therefore the best because in this position the directions of the leg and the heel lines have a tendency to coincide (angle C tends to become zero).

Effect of body weight distribution on angle C, barefoot. Subjects stood on a horizontal plane with feet parallel and six, 10, and 14 inches apart. They were asked to stand in three different manners: (1) with body weight evenly distributed over feet, (2) with weight shifted to the left foot, and (3) with weight shifted to the right foot. The object of this experiment was to determine how much error might be introduced in the measurement of angle C if the subject's stance was not correct (body weight was not equally distributed on both feet).

Analysis of variance (Table III) shows that there was a statistically significant effect of weight distribution upon angle C. Shifting of weight over one foot caused an increase in pronation of that foot and increase in supination of the other foot.

When body weight was unequally distributed, the difference between the angles C for the left and right foot was greater than when the weight was equally distributed. When, however, the average of angle C for both feet was calculated, it was found that the uneven weight distribution had little effect, if any, on the average. The differences were usually less than 2°. This was especially true for 10-inch distance between the feet. When weight was distributed evenly, the average of angle C for both feet was .6°; when weight was shifted to the left foot it became .7°; and when it was shifted to the right it became −.1°, the difference being only a small fraction of a degree.

Comparison of measurements of angle C made with manual goniometer and with photographic method. Subjects stood on either horizontal or inclined planes. Angle C was measured on the same subjects with the manual goniometer and with the photographic method. Altogether, 138 double measurements were made on 17 subjects. The difference between the means obtained with both methods of measurement was .2° and the coefficient of correlation .96. These findings proved that the manual goniometer is a reliable instrument and that it is justifiable now to dispense with the tedious photographic method.

Discussion

The supinating effect of the conventional and functional insoles. As in a previous investigation,[1] the additional supinating effect produced by the functional insole was not statistically significant. Again the question may be raised: Why should *everybody* have a supinating device incorporated into footgear construction? There are a great many people who increase the supinating effect of their footgear just by ordinary walking and by wearing off the outer side of the heel, thus making the medial side of the heel relatively higher.

Attention is called to the fact that the barefoot subjects in this group had a slight supination instead of pronation. This is just a matter of chance. Supination also was observed in some persons in the previous study.

Effect of distance between the feet and weight distribution. The distance of 10 inches between the parallel feet is the preferred distance because in normal legs the leg line and the heel line form an angle equal to zero. Body weight distribution will not affect the average value of angle C calculated for both feet. This can be done by placing a stand with a vertical rod in front of the subject, midway between the feet. If the contours formed by the rod and each leg are identical, weight distribution should be equal.

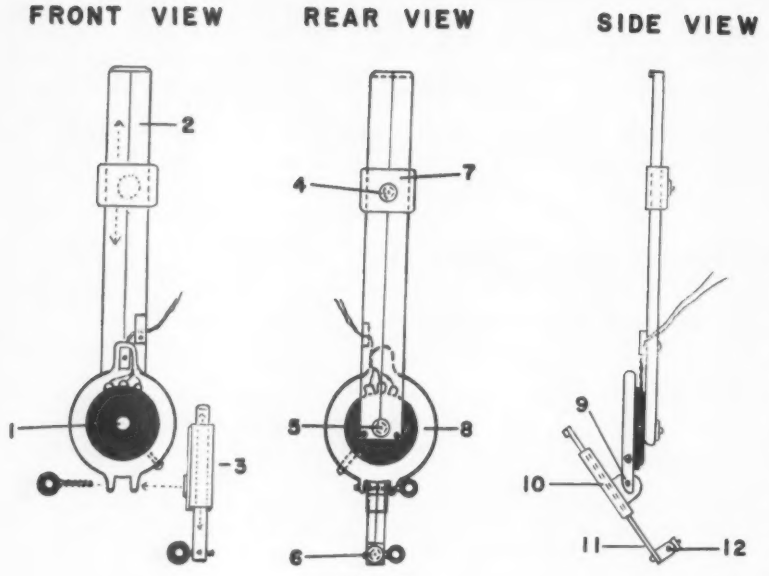

Figure 4

The introduction of the manual goniometer made the measurement of angle C much easier than with the use of a photographic method. In using this goniometer, the marking system described in this part of the article should be followed; otherwise, the results obtained will be either questionable or just wrong.

The Foot in Walking

At the beginning of the study of the foot in walking an attempt was made to measure angle C by the photographic method used in studying the foot in standing. Soon it became evident that this method would require taking a large number of photographs simultaneously from two directions and would demand an enormous amount of time for reducing photographic data to understandable terms. Almost in desperation, an electrogoniometer was invented. This instrument can be attached to the subject's foot, and angle C can be recorded automatically on an oscillograph. The new instrument was used exclusively in this part of the study, the foot in walking.

Materials and Methods

An electrogoniometer (Figure 4) is an instrument for automatic recording and measuring of degrees of movement in a joint. Essentially, it is a goniometer in which a rheostat has been substituted for the protractor. Electric current supplied by a small battery is sent through this rheostat to an oscillograph where changes in voltage are recorded and read off in degrees. The electrogoniometer for the talocalcaneal joint, used in this study, was developed, designed, and built by P. V. Karpovich and G. P. Karpovich. Since completion of this study a universal goniometer, which can be used on other joints has been developed.[2]

To measure angle C with the electrogoniometer, the center of the rheostat (1) is placed on the midtalocalcaneal point, the long shaft (2) is placed on the leg, and the short shaft (3) on the heel. The electrogoniometer is secured to the leg by means of snap fasteners. The sockets of the fasteners are attached to the middle of small plastic "saddles." These saddles are taped to the leg and foot, and the studs of the snap fasteners are attached to the electrogoniometer and then pressed into the sockets of the saddles.

The long shaft slides in a sleeve (7) to allow for dorsiplantar movements of the foot, and is attached to the housing of the rheostat. The short shaft essentially consists of a sleeve (10), through which passes a sliding bar (11) with a hinged stud of the fastener (12) at the lower end. The sleeve (10) is hinged to the frame (9) which in its turn is secured firmly to the knob of the rheostat. The sleeve of the short shaft and the hinges (9 and 12) allow adaptation of the goniometer to any shape of the heel and eliminate the interference of the dorsiflexion.

The rheostat used for the construction of the goniometer has 0 to 10,000 ohms of resistance, is one-quarter of an inch thick and five-eighths of an inch in diameter.

The plastic saddles used in this investigation ranged from one and one-half inches to two and one-half inches in length and from one-half inch to three-quarters inch in width. Their thickness was one-sixteenth inch. Each saddle had a slightly different contour, to best fit the contour of the leg and foot at different points. They were secured to the skin by one inch wide adhesive tape. To aid in accurate placing of the saddle, a piece of stiff wire was passed through the fastener of the saddle. The end of the wire was placed on the desired mark on the leg and the saddle was then moved toward the leg, taped to the skin, and then the wire was removed.

For calibration of the goniometer, a special 40° protractor was made, the midpoint of which

was designated 0 and the two halves of which were marked off from 1° to 20°. The center of the protractor had a socket snap in which the stud snap of the rheostat could be inserted. The long shaft of the goniometer was immobilized by another socket snap located directly above the center. A plastic extension, with a hairline drawn in the middle, was attached to the short shaft to aid in calibration.

For the sake of lightness and convenience in handling, it was desirable to make this instrument shorter and smaller than the manual goniometer used in the first part of this study. The change in the length of the shaft necessitated determination of a new mark on the leg to which the upper saddle and, therefore, the upper sleeve of the goniometer could be attached. This place should be close to the talocalcaneal joint and should remain on the "leg line" during changes of angle C.

For this purpose, an experiment was conducted on seven subjects. The leg lines were drawn on the skin of both legs, according to the directions given in the study of the foot in standing. The legs were then photographed in three positions: (1) normal, (2) maximum supination, and (3) maximum pronation.

Examination of photographs showed that during supination and pronation the leg line became distorted, forming either a C or S curve (Figure 5). The S curve intersected the true leg line at an average distance of 4.6 inches from the talocalcaneal point.

Since the distortion of the leg line, which assumed the shape of the letter C did not intersect the true leg line, it was important to find out what error would be made in measurement of the angle C if the upper sleeve of the goniometer were attached also 4.6 inches above the talocalcaneal center.

Measurements made on 18 subjects showed that the average error would be .63° and the range of error 0 to 1.5°. For this reason, it was decided to accept the point 4.6 inches above the talocalcaneal joint as the point of location of the stud anchoring the stud of the sleeve for the long shaft. For expendiency, 4.5 inches, instead of 4.6, was used.

Inasmuch as the central stud of the rheostat is held by the socket part of the snap, it is possible to assume that, if the position of the socket were not always related to the movement in the talocalcaneal joint, this would make the position of the center of the rheostat unrelated to movement and would cause an error in measurements. In order to investigate this situation, a "sandwich," made of two pieces of white paper and a piece of carbon paper in between, was placed over the socket so that the stud of the rheostat could move freely on the paper. Subjects were made to pronate and supinate their feet to the maximum and also to walk. At the end of each test the position of the socket was marked on the paper by a gentle pressure against the snap socket. It was found that the central stud remained remarkably close to the position of the socket. The average of the occasional deviations was one mm and mostly downward. Such a displacement reflected little, if at all, on the measurement of angle C. Thus, during subsequent experiments, the electrogoniometer was attached to the points four, two and three (Figure 1).

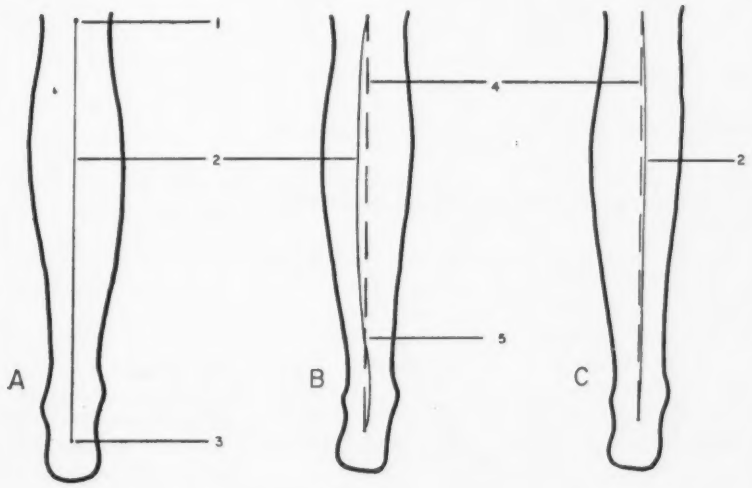

Figure 5

Distortion of the leg line due to skin and muscle movement during supination of the right foot. (A) Normal standing. (B) "S" curve distortion. (C) "C" curve distortion. (1) Mark 1. (2) Line drawn on skin. (3) Mark 2. (4) True leg line. (5) Intersection of line drawn on skin and true leg line.

Contact indicators. Flat electric switches were used to indicate the beginning and the end of contact of various parts of the sole with the ground. They were made of two small pieces of cigarette pack foil separated by a piece of perforated adhesive tape. Wires were attached to each piece of foil and the entire switch was covered on the outside by two one inch in

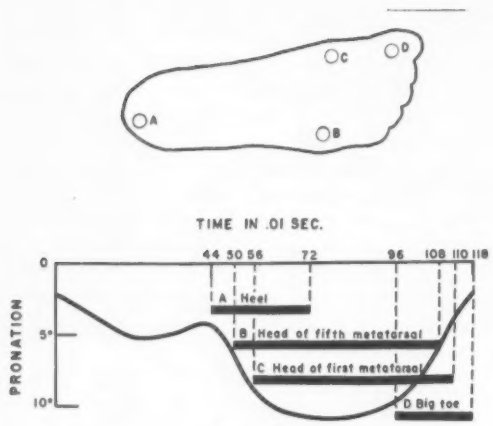

Figure 6

Angle C curve during walking and the sequence of ground contacts of four points on the sole of the foot.

diameter adhesive tape disks. Even a slight pressure was sufficient to cause a contact between the two pieces of foil. These switches were connected with the oscillograph for simultaneous recording of the changes in angle C. Walking was done on an electrically driven treadmill and also on the floor.

Simultaneous recording of the foot and leg position and angle C. Subjects had electrogoniometers attached to both legs and four flat switches (contact indicators) placed on the sole of each foot: (1) under the heel, half an inch from midline to the lateral side and on the most posterior point of the contact with the ground, (2) under the lateral protuberance of the head of the first metatarsal, (3) under the head of the fifth metatarsal; and (4) under the first phalanx of the big toe just next to the joint. Both the electrogoniometers were connected with the oscillograph. Because the oscillograph had four channels, only two of the contact indicators could be added simultaneously.

Simultaneously, with records from the electrogoniometers and contact indicators, photographs of the leg and foot were taken from the lateral view. Each time a photograph was taken, a mark was automatically made on the oscillograph. This method made it possible to establish the relationship between leg positions and duration of foot contacts with the ground (Figure 6).

Measuring degrees of angle C on the oscillogram. In order to facilitate analysis of the angle C curve, six points were selected on the curve as landmarks:

1. Big toe leaves the ground.
2. Midpoint of the air phase.
3. Heel touches the ground.
4. Toe of the other foot leaves the ground.
5. Midpoint of the ground phase.
6. Heel of the other foot touches the ground.

This selection was made after studying a number of oscillograms and foot photographs taken simultaneously. At first a *direct* method of measuring angle C was used. In this method every value of angle C at each of the six landmarks was measured and then averaged. This method is extremely time consuming, and therefore another method, called the "ruler method," was used. The ruler method is similar to that used in measuring oxygen consumption from records obtained in basal metabolism tests. In order to find oxygen consumption, a ruler is used to draw a line connecting the tips of expirations records. This line automatically gives the average rate of consumption for the entire test. In measuring angle C, the ruler was used to connect the identical parts in each step. It is very easy to recognize points one, two, three, and five. Points four and six are nothing but points one and three for the *other* foot and can be found when oscillograms of

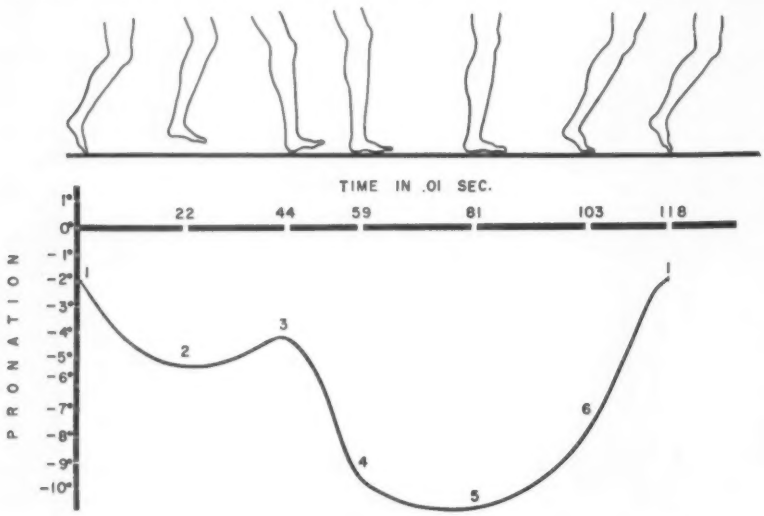

Figure 7

Relation between the position of the leg and foot and the angle C curve. (Medial view of the left leg shown). (1) Big toe leaves ground. (2) Midpoint of the air phase. (3) Heel touches the ground. (4) Big toe of the other foot leaves the ground. (5) Midpoint of the ground phase. (6) Heel of the other foot touches the ground.

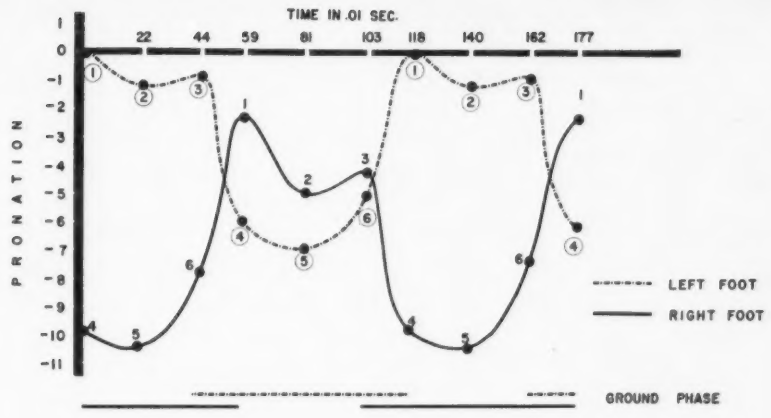

Figure 8

Angle C curves of the right and left foot during horizontal barefoot natural walking. (1) Big toe leaves the ground. (2) Midpoint of the air phase. (3) Heel touches the ground. (4) Big toe of the other foot leaves the ground. (5) Midpoint of the ground phase. (6) Heel of the other foot touches the ground.

both feet are obtained simultaneously. Before the ruler method was adapted, it was compared with the direct method (Table IV). The mean difference was not statistically significant.

Results

From data obtained on six normal subjects who walked barefoot on the treadmill and on the floor, typical curves were prepared (Figures 7 and 8). They show that the angle C during each step forms a curve which consists of two semicircular dips. One, shallow, corresponding to the "air phase" during which the foot is carried through the air; and the other, a deep one, corresponding to the "ground phase" during which the foot is in contact with the ground. The air phase in this figure occupies 0.44 seconds and the ground phase 0.74 seconds. The angle C is in pronation most of the time, especially during the ground phase. This can easily be understood because at that time the foot becomes weight bearing or "emphasized," and this has previously been shown to increase pronation.[1]

The ground phase begins (Figure 6) with the heel touching the ground; 0.05 seconds later the head of the fifth metatarsal, and 0.47 seconds later the big toe contacts the ground. Thus the duration of the ground contacts of these four parts are: (1) heel, 0.28 seconds; (2) head of the first metatarsal bone, 0.58 seconds; (3) head of the first metatarsal bone, 0.54 seconds; and (4) big toe, 0.22 seconds.

Table V and Figure 8 show that the variations in angle C for the right foot were greater than for the left. It may also be observed that the amount of pronation was greater in the right foot than in the left throughout the step.

Effect of speed and the length of step on angle C is shown in Table IV. Apparently, angle C was the same for speeds of 2.39 m.p.h. and 3.52 m.p.h. The increase in length of step, however, increased the amount of pronation during the ground phase.

From Table V and Figure 9 it may be seen that, compared to angle C during parallel walking, toeing-out increases pronation and toeing-in decreases it. Toeing-in walking caused the greatest change in angle C, the range being from +5.3 to −5.2.

From Table V one may see that angle C obtained during walking on a treadmill and on the ground were the same.

Discussion

Although the measurement of angle C on oscillograms can be easily made with special scanning machines, these machines are expensive and not always available. The "ruler" method represents a simple, practical, and reliable method.

It was found that during natural walking the amplitude of angle C and the amount of pronation of the right foot were greater than for the left foot. This occurs because, in walking, the right foot toes-out more than the left foot.[3] It was shown in this study that toeing-out increases pronation.

There has been a great deal of debate regarding the correct position of the feet in walking. Some writers have advocated toeing-in and others, the parallel position.[4] One of the factors frequently contributing to foot discomfort is excessive pronation.[4-7] If this be true, then reduction in the amount of pronation would be beneficial. Toeing-out, therefore, should be avoided.

Exaggerated toeing-in as used in this study is, however, uncomfortable and subjects tend to lose their balance. This type of walking, therefore, cannot be recommended.

Summary and Conclusions

A study of pronation and supination of the human foot (1) in standing and (2) in walking was carried out.

1. *The foot in standing.* The supinating effect

TABLE IV.
Comparison between direct and "ruler" measurements of angle C

DIRECT MEASUREMENTS

M. P. H.	Type of walking	Landmarks, left foot 1	2	3	4	5	6	Landmarks, right foot 1	2	3	4	5	6
2.39	Natural	—.4	—2.5	.1	—5.5	—6.7	—6.7	1.4	—1.5	0	—3.8	—6.1	—4.7
	Toeing-out	—2.4	—3.9	—.1	—5.6	—6.1	—6.7	—2.3	—3.2	.8	—4.1	—4.6	—3.9
	Parallel	—.3	—2.3	—.3	—4.8	—4.7	—4.7	—.8	—1.5	.6	—4.0	—5.0	—3.9
	Toeing-in	8.2	1.3	2.9	—.6	—2.3	—1.6	11.0	1.8	1.3	—2.5	—3.3	—2.7
2.84	Natural	.7	—2.6	—1.1	—6.1	—6.5	—6.7	5.4	—.7	1.2	—3.4	—3.9	—1.9
	Natural*	.2	—2.9	0	—5.4	—5.4	—6.1	1.7	—2.7	.3	4.9	—5.0	—4.0
	Long steps	1.5	—2.4	1.0	—5.1	—5.1	—5.6	.7	—.9	2.5	—4.1	—3.9	—3.2
	Short-steps	.7	—1.8	—1.1	—3.7	—4.8	—3.4	.5	—2.0	.7	—3.6	—5.8	—3.4
3.52	Natural	2.6	—2.2	2.1	—3.7	—4.9	—3.9	4.9	—1.6	1.8	—3.4	—3.4	—1.3

Negative sign indicates pronation.

"RULER" MEASUREMENTS

M.P.H.	Type of walking	Landmarks, left foot 1	2	3	4	5	6	Landmarks, right foot 1	2	3	4	5	6
2.39	Natural	0	—2	0	—5	—7	—5	1	—1	1	—6	—7	—5
	Toeing-out	—2	—4	0	—6	—7	—4	—2	—3	0	—5	—5	—4
	Parallel	—1	—3	0	—5	—6	—2	—1	—2	0	—4	—5	—4
	Toeing-in	10	4	2	0	—3	0	10	2	2	—4	—5	—2
2.84	Natural	1	—2	1	—6	—7	—5	4	—1	1	—4	—4	0
	Natural*	0	—3	0	—4	—5	—4	2	—1	1	—5	—4	0
	Long steps	1	—1	0	4	—7	—3	—1	1	3	—4	—5	—4
	Short-steps	1	—2	1	—5	—6	—4	1	—2	0	—4	—6	—4
3.52	Natural	1	—3	1	—4	—5	—4	4	—2	2	—4	—6	—3

*Walking on the ground

Measurement method	Degrees of freedom	Mean	Difference between means Diff.	S. E. Diff.	T-ratio
Direct	108	—2.154			
"Ruler"	108	—2.018	—.136	.447	.304

The difference is not statistically significant.

of footgear with conventional and functional insoles was compared in subjects standing on a horizontal plane. With conventional insoles there was 5.4° of supination, whereas the functional insoles produced 6.3°. The difference, however, was not statistically significant. In subjects standing on inclined planes adjusted at 5°, 10°, 15°, and 20° of pronation, the functional insoles caused no statistically significant supinating effect. The need of an increase in supination for everybody was questioned.

For a diagnostic examination, a distance of 10 inches between parallel feet is preferred because the angle C at that position tends to be zero; therefore, deviations may be more easily observed. During an examination, the body weight should be evenly distributed because shifting weight to one foot increases pronation in that foot. The manual goniometer for measuring angle C was described. This instrument should supplant the time-consuming photographic method. The accuracy of this instrument is high. The difference between the means obtained with photographic and goniometric methods was 0.2° and the coefficient of correlation 0.96.

2. *The foot in walking.* An electrogoniometer was developed as an aid in studying the foot in walking. This instrument can be used for automatic recording or quick direct measuring of angle C.

TABLE V.
Average degrees of angle C at six landmarks on the angle C curve for various types of walking (six subjects)

M.P.H.	Type of walking	LEFT FOOT Landmark number 1	2	3	4	5	6	RIGHT FOOT Landmark number 1	2	3	4	5	6
2.39	Natural	—.5°	—2.2°	—1.2°	—6.7°	—7.8°	—5.7°	—2.5°	—5.0°	—4.0°	—9.7°	—10.7°	—8.8°
	Toeing-out	—4.0	—3.5	—2.0	—7.3	—7.2	—6.2	—7.0	—6.8	—5.3	—10.8	—11.0	—9.5
	Parallel	—7.7	—1.7	—.3	—5.5	—5.7	—3.8	—2.8	—4.8	—3.8	—7.8	—9.3	—6.7
	Toeing-in	5.3	—1.7	2.3	—1.8	—4.2	—1.8	4.8	—2.8	—2.5	—7.3	—1.3	—5.2
2.84	Natural	.5	—1.7	—.5	—6.0	—6.5	—5.2	—1.8	—5.5	—4.3	—10.0	—10.5	—8.0
	Natural*	—.2	—2.5	—1.0	—6.2	—6.7	—5.3	—2.3	—4.5	—4.0	—10.5	—10.8	—7.3
	Long steps	0	—2.0	—.7	—6.3	—8.3	—6.2	—2.3	—4.5	—4.0	—10.3	—11.2	—9.7
	Short steps	—.5	—2.0	—.8	—6.2	—6.5	—4.5	—3.3	—5.7	—4.3	—9.3	—10.5	—6.7
3.52	Natural	.3	—2.3	—.8	—6.8	—7.5	—5.7	—1.7	—4.8	—3.5	—9.7	—10.8	—7.3
Grand average for all natural walking		0	—1.4	—.9	—6.1	—7.1	—5.5	—2.1	—5.3	—4.2	—10.0	—10.7	—7.9

*Walking on the ground. Negative sign indicates pronation.

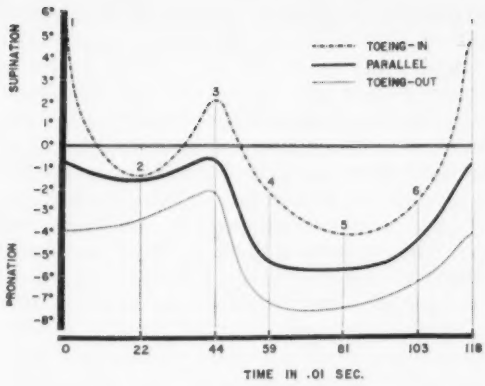

Figure 9

Angle C curves obtained on the left foot in toeing-in, parallel, and toeing-out walking. (1) Big toe leaves the ground. (2) Midpoint of the air phase. (3) Heel touches the ground. (4) Big toe of the other foot leaves the ground. (5) Midpoint of the ground phase. (6) Heel of the other foot touches the ground.

A typical angle C curve consists of two arcuate dips. One is shallow, corresponding to the air phase during which the foot travels through the air, and the other a deep one, corresponding to the ground phase. In most people angle C is in pronation. The right foot is more pronated than the left foot. Toeing-out increases and toeing-in decreases pronation. Angle C was the same for speeds of 2.39 m.p.h. and 3.52 m.p.h. Increase in length of step increased pronation. Angle C was the same when subjects walked on treadmill and on the floor.

Electrogoniometers for other joints are being developed. The development of the electrogoniometer has opened a new avenue for study of normal and abnormal joints in motion.

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What's Your Excuse?

The reasons most fat people, even when under medical care for their obesity, do not lose weight successfully are: one in three really doesn't want to, one in five is too dumb, one in five has to overeat to obtain emotional satisfaction.

These are the conclusions of two Philadelphia physicians, Donald Berkowitz, M.D., and Nathaniel Berk, M.D. They studied 100 patients referred to the obesity clinic of a union health center whose weights varied from 151 to 320 pounds and all of whom were at least 20% overweight.

All were given thorough medical examinations before being treated. Treatment consisted of education, reduction of food, an appetite suppressant drug, exercise, and psychotherapy.

Thirty-eight of the 100 did not finish the course. Practically all gained weight after stopping treatment, and 19 in this group gained beyond their original weight.

Of the remainder, 42 lost 20 pounds or more, one woman 70 pounds — from 320.

Twenty lost less than 20 pounds and six were discharged after having reduced to normal weight. Fifty-six remained under treatment at the end of a year.

The basic facts of human nutrition, and an attempt to "brain wash" the patients of nutritional fancies, constituted the educational effort. The doctors decided that 20% just could not grasp the lessons.

All the patients were given levoamphetamine alginate as an appetite suppressant three times daily before meals. Some also received methamphetamine alginate which both suppresses appetite and elevates mood. Again 20% failed because the emotional need to eat did not depend on appetite.

Posture control was demonstrated and moderate daily exercise was prescribed. The patients were seen and counseled every two to four weeks. Half of the 58 failures (those who withdrew plus those who lost less than 20 pounds) were judged to lack motivation.

Abstracts

Adrenocortical Function after Major Surgical Operations and Thermal Trauma In Man

by K. MARKLEY, M. BOCANEGRA, E. EGO-AGUIRRE, M. CHIAPPORI, and G. MORALES in *Surgery*, March, 1960

The augmented adrenocortical activity after trauma has been measured by the rapid fall of circulating eosinophils in the peripheral blood, by retention of sodium and increased excretion of potassium in sweat and urine, by increased steroid excretion in the urine, and by increased plasma levels of 17-hydroxycorticosteroids.

In this study adrenocortical function has been determined by the measurement of urinary 17-hydroxycorticosteroid and 17-ketosteroid excretion. To test whether the adrenal response was maximal under conditions of trauma, where it is believed that endogenous ACTH production is increased, the excretion of 17-hydroxycorticosteroids and 17-ketosteroids was determined during the early post-trauma period in the absence as well as in the presence of exogenous ACTH administered intravenously.

The results of this study demonstrate that 17-hydroxycorticosteroid excretion was maximal only after extensive injury due to thermal trauma, since exogenous ACTH significantly stimulated an increased 17-hydroxycorticosteroid excretion after major surgical operation and moderate thermal injury. 17-ketosteroid excretion, however was maximal, after all grades of thermal trauma but not after major surgical operations. —W.A. WICHOWSKI, M.D.

Letters

To The Editor:

An editorial, entitled "What is a Profession," in the April number of *Industrial Medicine and Surgery* brought back some amusing recollections.

Many years ago Dr. Joseph Jastrow published an article entitled "The Psychologist Looks at the Doctor." I do not have the article before me nor am I sure where it was published, but I believe it was in the *Journal of the American Medical Association*. Dr. Jastrow at the time was Professor of Psychology at the University of Wisconsin. He introduced his subject by defining a profession as contrasted with a business or trade. A business or trade, said Dr. Jastrow, worked toward its own aggrandizment. It considered itself successful only when it had a greater volume this year than it did last year; only when the demand for its product or service was greater this year than it was last year; only when it created a greater demand for its product or service. A profession, on the other hand, worked toward its own suicide. The clergyman would never consider himself wholly successful until his flock so walked in the paths of rectitude that they had no further need for his ministrations. The teacher would consider himself successful only when he had taught his students all there was to know and he could enjoy a continuous sabbatical year. The medical profession, he said, had long been noted for its efforts to destroy the things which made it necessary. When it came to the law, Dr. Jastrow was not quite sure it could qualify as a profession under his definition.

I only hope to amuse you for a few moments and to show you that before now persons have wrestled with the problem of defining a profession. However, I am sure that industrial hygiene will qualify under Dr. Jastrow's definition.

Yours very truly,
G. K. FENN, M.D.

Books

Law and Medicine

WILLIAM J. CURRAN (Boston: Little, Brown and Co., 1959) $12.50

This large book is written by an attorney and is addressed to lawyers and law students. Medicine enters chiefly as the object of analysis. At one point the author states: "The practice of law and of medicine are proud professions. There is art and there is science in each. Strangely enough, as each develops more specialization, the overlapping of problems between the two becomes more apparent. On the trial level in our courts and before administrative agencies, medical proof is involved in over 80% of all litigated cases. The methods of medical proof, the utilization of expert medical witnesses, and the preparation of medicolegal cases in general require of the attorney skills and training to which he has rarely been exposed in law school or in ordinary legal practice. On the legislative level, lawyers are engaging more and more in formulating and interpreting complicated public programs involving issues of health and medicine. The advances of medical science press

upon the law with new and impatient demands, all of which we lawyers must answer.

"After eight years of teaching in the field, the editor has no illusions that this book will make physicians of its lawyer-readers. In fact, no such attempt is made. Rather it is intended to provide a background to medical knowledge and applied legal skills which will enable the lawyer to deal effectively with medical issues.

"There may have been a time when doctors and lawyers had much in common, but today their environments are radically divergent and the problem of mutual understanding is a real one. The doctor is trained in a dynamic and experimental science, he is seeking truth in a physical world. He is steeped in the practical judgment, though he avoids generalization. The lawyer, on the other hand, lives within the generalities of the law. The courts apply justice through the advocacy system and seek truth through the burden of proof. When the doctor or other medical person comes into contact with the courts and lawyers, he is often mystified and is generally impatient with the conservatism of the courts in accepting the advances of science. The lawyer often does not seem to the doctor to be seeking truth, but only to place blame.

"And so, many a practicing lawyer has complained, 'Doctors just don't think like lawyers.' "

The statement "Doctors just don't think like lawyers" may be paraphrased by this one: "Lawyers just don't write like doctors." That leads to the statement that much of the superb content of this book utilizes language so distinctly legal that it becomes difficult for a physician to comprehend all that is presented. While this book may not be proffered to industrial physicians as prospectively useful day by day, it will prove invaluable to a small number who find themselves frequently participating in forensic medicine. This book's chief divisions are: Orientation to Medical Science and the Medical Professions; The Process of Medical Diagnosis and Case Management; An Anatomy of Trauma; Medical Proof in Litigation; Psychiatry and Law; Government Regulation in Medicine and Public Health. This is a magnificent presentation of medicine and the medical profession to attorneys.

Adventure To Motherhood

J. ALLAN OFFEN, M.D. (Miami, Fla.: Audio Visual Education Co. of America, Inc., 1960) Cloth, 72 pages, $2.95; paper bound edition $1.95

This compact and beautifully illustrated handbook represents an entirely new approach to patient education in a field where patient understanding and emotional security are most important factors.

Adventure To Motherhood differs entirely in format and presentation from the dozen or so books currently available in the field of obstetrics for patient use. The text is concise, factual, and lucid. The attractive color photographs of a typical young wife from the time she first comes to the doctor's office suspecting pregnancy through her entire prenatal period and the actual delivery of her baby tells a story of universal interest in most acceptable fashion. The illustrations save thousands of words and depict pregnancy as a great experience. The succinct and appropriate caption-like text reads just as a physician would speak to his patient and communicates clearly just what the pregnant woman should do. This straightforward and complete presentation should do much to dispel old wives' tales, to allay the fears and to establish confidence of the reader in her physician. The book avoids all controversial areas leaving these to the individual physician. Furthermore, unlike other prenatal books we have seen, *Adventure To Motherhood* is nonencyclopedic and does not deal with abnormalities of obstetrics but rather shows a happy, healthy pregnancy successfully concluded with the aid of the physician.

While this unique picture story will undoubtedly stand on its own merit as a book, the publishers are making it the cornerstone of an equally unique total program under the title of the *Busy Doctor's Time-Saver Kit* for physicians engaged in obstetrical practice. This kit consists of a self-taking obstetrical history, a notebook size hospital information supplement sheet, and 23 supplementary leaflets bearing such likely titles as: Postpartum Instructions; Diabetes In Pregnancy; The Rh Factor; Cesarean Section; Constipation, etc. These addenda to the book are written in the same concise style and supply noncontroversial information about each condition which the doctor can easily and quickly interpret in terms of the particular patient to whom it applies.

The kit is cleverly conceived to allow the doctor using it to individualize and establish rapport in the case of each patient. At the same time it allows him to maintain the most complete and standardized records and to approach the patient in a scientific but completely personal manner. All of this is accomplished in a minimum amount of time. These factors make it of unique value in an industrial medical application.

We predict that the book and the companion program will be enthusiastically received by busy practitioners. *Busy Doctor's Time-Saver Kits* in other fields also are in preparation.

Recent Advances in Respiratory Tuberculosis

by *Frederick Heaf, M.D.* and *N. Lloyd Rusby, M.A.* (Boston: Little, Brown and Company, 1959) illustrated, $8.00

During the 10 years that have elapsed since the publication of the last edition of this book profound changes have taken place in the control and management of respiratory tuberculosis and the mortality from the disease has been reduced in almost all parts of the world. The time has not arrived when a complacent attitude can be adopted. If the eradication of tuberculosis is considered as a global and not merely a national endeavor, many complex issues remain to be settled and methods of control which have proved successful in the past must be extended and employed with unabated vigor. Indeed, the importance of regarding tuberculosis as an international problem has become more widely appreciated in recent years and marks a notable development in the modern approach to the disease.

The purpose of this book is pursued under these major categories: epidemiology, prevention, tuberculin and tuberculin testing, B.C.G. vaccination, chemotherapy, collapse therapy, treatment by resection, primary tuberculosis, respiratory function studies, chest radiography, rehabilitation, some miscellaneous advances, definitions, classifications, statistics and recent legislation.

While every industrial physician ever is on the qui vive as to tuberculosis, added concern is in tuberculosis as it may occur along with silicosis. On that point this language appears, "Vorwald and his colleagues (1950) have made some interesting observations on the course of the B.C.G. lesion in the presence of silicosis. They found that the tissue resistance of guinea pigs to B.C.G. was lowered by quartz particles so much that the dose used for vaccination or infection by inhalation could produce progressive and fatal tuberculosis. The virulence of B.C.G. organisms recovered from the tissue of these silicotic guinea pigs was unaltered. The fact that viable B.C.G. were recovered from the lungs and tracheobronchial lymph nodes of the tuberculosilicotic animals up to 18 months after vaccination is important. It would seem that it is no longer possible to maintain that the organisms of B.C.G. are unable to produce progressive tuberculosis under any conditions." The inference is that whatever the merits of B.C.G. vaccine, it is no boon for the silicotic.

This small book lives up to its expressed intentions. It is an unelaborate concise appraisal of newness in tuberculosis in all its major ramifications. The library of every industrial physician needs at least one book on tuberculosis. This one offers much.

Curriculum Study of the Occupational Health Aspects of Nursing

HEIDE L. HENRIKSEN (Minneapolis: University of Minnesota, 1959) 112 pp., $2.25

Postmature, but healthy, is this report of a two-year study conducted in Minnesota, "to determine the essentials of occupational health which should be included in the basic nursing curriculum." Postmature — for since 1917 sporadic efforts have been made to provide education in occupational health nursing. The program director-author of this report relates there is very little indication that occupational health is now part of the basic nursing preparation, and only one program for advanced study was known to exist in the United States.

To determine nursing functions and program trends in occupational health, a questionnaire survey was conducted among occupational health nurses, industrial physicians, management and employees. The results indicated the same basic health services are required in any employee health service regardless of occupation.

During the two-year period, the project director met with faculty members from six collegiate schools of nursing to discuss curriculum goals and content, and to explore the possibility of integrating occupational health concepts within the present curricula structure. It was determined, and examples given, that this could be done without the addition of extra courses. However, questions raised during the exploration of this subject indicated occupational health nursing, in a one-nurse unit, could not generally be considered a first level position. Therefore, basic nursing education would serve mainly to acquaint the students with this specialty. Some consideration was given to further preparation which would enable the nurse to function adequately in industry, and would eliminate the hit-and-miss methods which have so often had to be used in the past.

The project was undertaken with a special grant from the American Journal of Nursing Company to the Minnesota League for Nursing. In the report many thought provoking questions are raised, each of which would be worthy of further research. A wealth of material is sandwiched between the description and methodology of the project. As a climax, the author invites others to support and continue what she so truly calls "an adventure in cooperation."

—IRENE D. COURTENAY

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Incident at Chicago

The 1960 report of Dr. Whittaker's History Committee regarding the forthcoming book, *Occupational Health in America — The Evolution of the Industrial Medical Association*, remarks that no one knows just when, or to whom, the idea of such a history suggested itself, but that "a history of some sort" was officially discussed by the AAIP&S in the early 1940's, and talked about among the older members prior to that time. In that connection the following incident is related.

In 1937 one of the editors of this Journal proposed that the group photograph of the organization meeting of the American Association of Industrial Physicians & Surgeons at Detroit in June, 1916, be published, together with the list of those present. This would appear in the Journal as a two-page spread, with the names above and below the halftone panel. For that purpose the late Dr. Harry Mock lent the framed photograph that hung on his office wall, and from it the necessary halftone plates were engraved and sent to the printer. Only then was it discovered that there was no list. If any register had been kept, it was lost. In the hope that they might furnish some names, proofs of the halftone plates were sent to those Association members most likely to have knowledge or recollection of the occasion, but from the 50 or more thus contacted only two identifications were forthcoming. Still undaunted, the editor had a full-size glass transparency of the picture made, and this was mounted in a box with a light behind it and set up in a prominent place in the exhibit room at the Thirty-Third Annual Meeting of the Association at the Palmer House in Chicago in June, 1938. The older members were asked to study it, and see whom they could recognize. Among the most interested were Drs. Loyal Shoudy, Cassius Watson, and Otto Geier. Nearly everyone commented on the appearance of the same man at both ends of the picture. How he got from one end of the line to the other in time to be photographed at both is still a mystery — second only to the mystery of who they were that stood "between him," for only seven of the more than a hundred could be named.

In expressing his disappointment to Dr. Shoudy, the editor said: "Why don't you elect or appoint an official historian, to preserve the record at least from now on? Twenty years from now there'll be as much interest in what's being done here today as there is today in what was done 22 years ago in Detroit." Dr. Shoudy replied that the minutes of the meetings as they were accumulating year by year ought to con-

stitute a pretty good record. The editor agreed. "But," he added, "there isn't much sparkle in a chronology."

Dr. Shoudy was reelected to the Board of Directors at that meeting in 1938. Before leaving Chicago he told the editor that he had put before the Board the proposal to create a history committee. The Journal's project involving the group photograph was abandoned; the halftones gathered dust in the printer's cabinet for a year or so and finally were scrapped. Dr. Whittaker's 1960 report says: "In 1942, a 'committee for the purpose of preparing a history' was established." Dr. Shoudy was its first chairman. The group photograph of the organization meeting in 1916 is reproduced in the forthcoming history — but still without the names. —A.D.C.

Dexterity

It is commonplace knowledge that the new worker in industry, the "green hand," goes about his duties clumsily, using unnecessary muscle groups, spoiling much work material, becoming temporarily accident prone and developing fatigue out of proportion to the impositions of the tasks. In time this gives way to ease, comfort, dexterity and facility in the work performance.

What is not commonplace knowledge is that there exists a precise mental and nervous mechanism that governs such adjustments. The late Philip Mitchell in his *A Textbook of General Physiology* writing about "Habits as Developed Reflexes" makes much clear:

"The common expression, 'act by force of habit,' implies the mechanical nature of activities that are habitual, for the words suggest that one can respond to a given set of conditions in only one way. But acts that eventually become habitual are not done in this seemingly mechanical way at first. The application of automobile brakes at the right time requires careful thought and fixed attention on the part of a beginning driver; but after driving becomes habitual to him, any circumstances which necessitate stopping result in application of the brakes by the driver, even though his attention appears to be fixed on other matters, and the habitual driver is very apt to find himself involuntarily making the motions of putting on the brake when someone else is driving the automobile. Training appears to make one react automatically. Many illustrations could be given. All skilled actions, handling of machinery and tools, playing musical instruments, making the movements required in any skillful athletic game, and the ordinary acts that are daily performed by human beings, come to be comparatively automatic. The movements for any such acts, at first slow and awkward, become easier and easier with repetition until they are finally done with no apparent attention. 'Practice makes perfect.' Even such common acts as standing erect and walking are really habits which must be slowly and difficultly acquired by the child. The power to acquire habits is of great value in human life. Most of our everyday acts are performed without the need of special attention; in a reflex manner. Were this not the case, mental activity would need to be concentrated continually upon the acts necessary for mere existence, but acquisition of new reflexes gives the mind freedom to gain new knowledge.

"Human progress is thus primarily dependent upon the ability to acquire habits. From the standpoint of physiology, habits may be defined as acts which are done at first in a typically voluntary way but which, after sufficient repetition, are done in a comparatively reflex way. A physiological explanation of the acquisition of habits is based on the assumption that habit forming involves the establishment of new reflex paths. The resulting arcs, however, are not composed of new neurons, for a vertebrate is born with the same number of neurons that it possesses throughout life. The new paths are not built but merely become functional for reflex acts. Repeated use of certain neurons appears to wear a path across them. According to the theory of synapses, the paths of conduction between certain receptors and effectors are at first partly blocked and can only slowly become comparatively open as a result of repeated voluntary use. The explanation also assumes that numerous other possible paths which should be blocked to further the efficient performance of the given act, are at first comparatively open. This part of the explanation is designed to account for the fact that many muscles are used unnecessarily during the first awkward attempts of a person who is learning how to perform a skilled act. His coordination is imperfectly adjusted for the given performance. With acquisition of skill, the paths conducting excitation unnecessarily are blocked so that a skilled person does not use his muscles inefficiently. This is the chief reason why a skilled worker is less fatigued by the performance of a given amount of work than is a 'green hand.' The acquisition of skill or of any habit means the development of special paths due, in the theory of synapses, to new adjustments of graded synaptic resistance."

One no longer need wonder why the skilled concert pianist even when on tour still daily must go about three to six hours of grueling practice. He is keeping his reflex channels open. Otherwise, soon he would not be the great artist.

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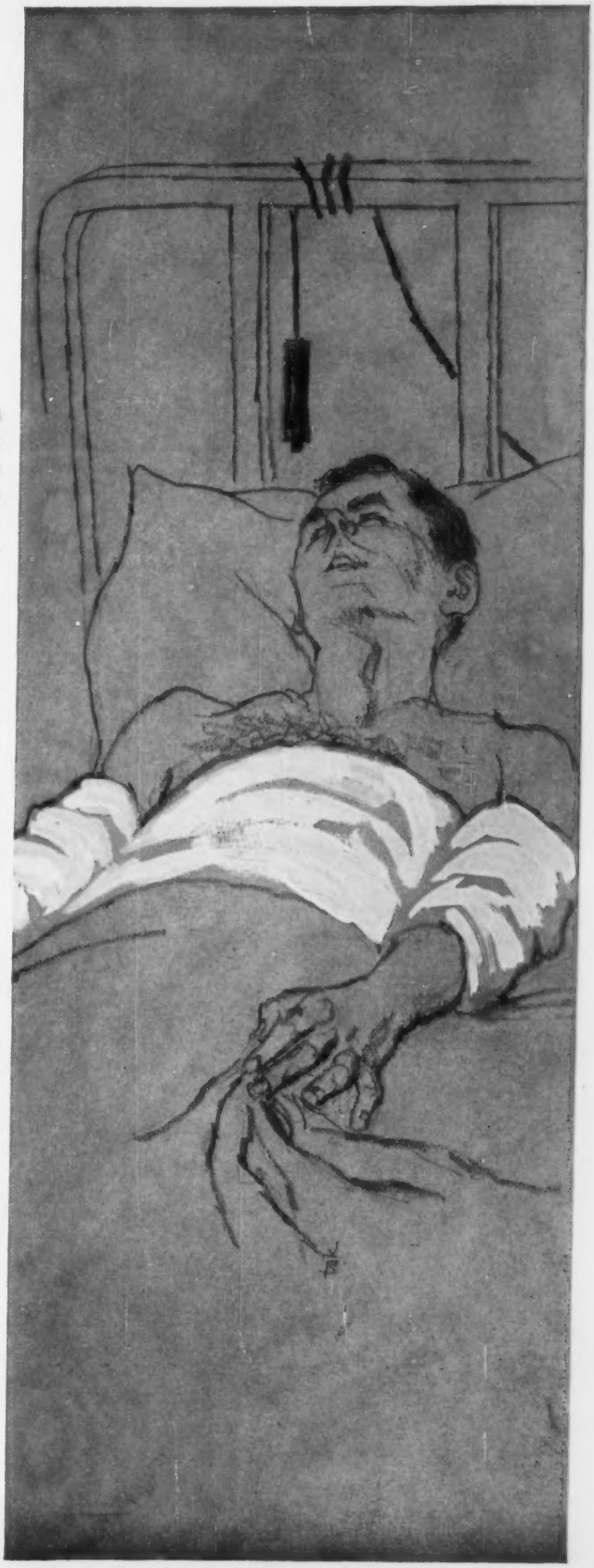

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1. Eisen, H. N., and Tabachnick, M.: Protein Metabolism, M. Clin. North America 39:863 (May) 1955. 2. Jamison, R. M.: General Nutritive Deficiency, Virginia M. Month. 83:67 (Feb.) 1956. 3. Goldfarb, A. F.; Napp, E. E.; Stone, M. L.; Zuckerman, M. B., and Simon, J.: The Anabolic Effects of Norethandrolone, a 19-Nortestosterone Derivative, Obst. & Gynec. 11:454 (April) 1958. 4. Batson, R.: Investigator's Report, Feb. 11, 1956. 5. Weston, R. E.; Isaacs, M. C.; Rosenblum, R.; Gibbons, D. M., and Grossman, J.: Metabolic Effects of an Anabolic Steroid, 17-Alpha-Ethyl-17-Hydroxy-Norandrostenone, in Human Subjects, J. Clin. Invest. 35:744 (June) 1956. 6. Brown, C. H.: The Treatment of Acute and Chronic Ulcerative Colitis, Am. Pract. & Digest Treat. 9:405 (March) 1958.

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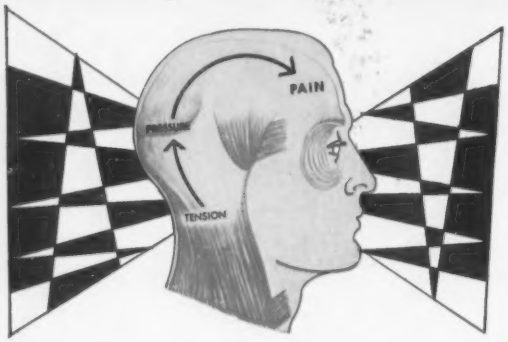

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COMMENT AND OPINION

Medical Cards

Wallet size medical information cards to record immunizations, drug allergies, and chronic ailments (such as diabetes or high blood pressure), are distributed to employees in all affiliates of First Bank Stock Corp., St. Paul, Minn.

—*Industrial Relations News*, May 28, 1960.

Government in Medicine

More than half the adult population favors government help in obtaining low-cost medical and hospital care. About one in three believe present government activity in this area should be increased. But many Americans have no opinion on this controversial question. These are the major findings of two University of Michigan studies on public attitudes toward government participation in health and hospital care.

The first study was conducted by the University of Michigan Survey Research Center with a national sample of nearly 2,000 adults in late 1956, while the second was done by the University of Michigan Detroit Area Study with 860 interviews in Wayne County early in 1957. Results were similar in both cases.

Fifty-five percent of those interviewed in the national study felt the government should "help people get doctors and hospital care at low cost." Twenty-five percent were opposed to government help, while 20% had no opinion. In the Detroit study, 63% favored governmental assistance, while 23% were opposed.

Participants in the national study also were asked, "Is the government going too far or doing less than it should?" in helping provide low-cost hospital and medical care. Responses were: not enough, 34%; about right, 23%; too much, 2%; and no opinion, 41%.

In Wayne County, the proportions were: not enough, 37%; about right, 32%; too much, 5%; don't know, no opinion, not ascertained, 26%.

Older people were more likely to favor government help in getting low cost and to feel the government wasn't doing enough in this field. Among those age 65 and over, with an opinion, 63% felt present government help was not enough, 31% said it was about right, and 6% believed it was too much.

"There is a tendency for political conservatism to increase with age," the authors noted. Yet the survey findings indicate that "older persons who might otherwise favor a smaller role for government in general make an important exception to this principle when it comes to financing medical care costs."

Just Mixed Up

At a recent forum on the problems of keeping employees happy, Robert N. McMurry, M.D., of Chicago told of a type of worker who seems to hate everybody, particularly the boss. He told of one such youth in an automobile factory who "got his 'kicks' from welding pop bottles in somewhat inaccessible places in the automobile bodies. As a result, when the car was assembled and taken out for the final trial run, there would be a rattle which nobody would be quite able to locate. In consequence, the car would have to be almost totally disassembled . . ."

The question is, why did the employee act this way?

Dr. McMurry also identified a type of employee who has suspicions that other employees don't like him and are ridiculing him behind his back.

He told about the head of an electrical workers union local in Chicago which had many women members. Some of the women would call the head of the local and demand that he do something because, "People on my job are talking about me. Sometimes it is the other girls who are talking about me; sometimes it is the foreman who is saying things about me that just aren't fair . . ." When one extreme case complained that the criticisms were coming out of her TV set, the union official said he would send his "secret agents" to investigate. He reported that they

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Staff Physician: Two years, private pract experience; now seeks advantage of salaried Indus position; seeks post where Int Med & cardio trng will be of value; Age 37.

Staff Physician: 5 yrs, priv. genl pract; seeks Indus post only; prefs Tex, La, So. Carolina, will consider foreign; Age 28.

Staff Physician: Seeks primarily foreign appt, will consider others; 2 yrs, private pract; 4 yrs, Indus Med; Age 34.

Staff Physician: 28; strong interest career indus med; MD, Boston univ, S of M; 2 yrs, med ofc, USN; presently Sr med ofc, USN ordnc dept; mil serv compltd; any locality; DNB immed avail.

Staff Physician: MPH, Univ of Mich; MD, Colo; 1 year, post-grad, Indus Hlth, Harvard; 6 yrs, Indus phys, important oil co; seeks full-time indus hlth work—dir active med, Indus hygiene & safety progm; Kansas City area; Age 36.

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had stopped the whispering behind the member's back; and she seemed satisfied with this ruse for a time.

Why do these women develop such problems?

At the same forum (sponsored by the Connecticut Mutual Life Insurance Co.), Norman Plummer, M.D., Medical Director of the New York Telephone Co., discussed the differences in absenteeism among men and women. He reported that his company's records showed that absences because of illness were twice as high in women as in men but that men are more likely to suffer life-endangering illnesses. He concluded: "It seems likely that the higher incidence of illness reported by women, the greater amount of disability that they experience and the greater number of visits that they make to the doctor is largely the result of culturally determined differences in their attitude toward what constitutes illness and what creates an acceptable reason for disability."

Are women a weaker sex because they give in more easily to sickness or are they the stronger sex because they take care of themselves and live longer than men?

These examples illustrate the broad national problem involved in helping people to keep regularly at their jobs and to get along with each other. The maladjusted employee is a trouble-maker, he changes jobs frequently and he may be accident-prone. Such poor adjustments and unnecessary absenteeism cost industry an estimated three billion dollars a year. Alcoholism alone causes industrial losses estimated at a billion dollars a year.

—*Waterloo* (Ia.) *Courier*, March 24, 1960.

Heads Up

Safety helmets dramatize the importance of accident prevention at Lehigh Portland Cement Co., Allentown, Pa. Each month a safety hat for each department is hung over a sign reading "Accident Free Departments." If a member from any department is injured, his department's hat is moved over a sign reading "Accident Medical Cases"; if the case develops into a lost-time injury, the hat stays there for the remainder of the year.

—*Industrial Relations News*, May 28, 1960.

Mental Bottlenecks

Ten percent of any industrial population has sufficient psychiatric problems to affect work, said Dr. Alan A. MacLean, Psychiatric Consultant for International Business Machines Corp., at the first clinical session of the Kentucky Industrial Medical Association.

Dr. MacLean, reporting on a study of psychiatric problems in eight industrial plants, noted that such a percentage of psychiatric ills would represent a substantial payroll problem for any corporation. However, industry realizes the importance of mental health and is taking steps to improve the mental health of employees.

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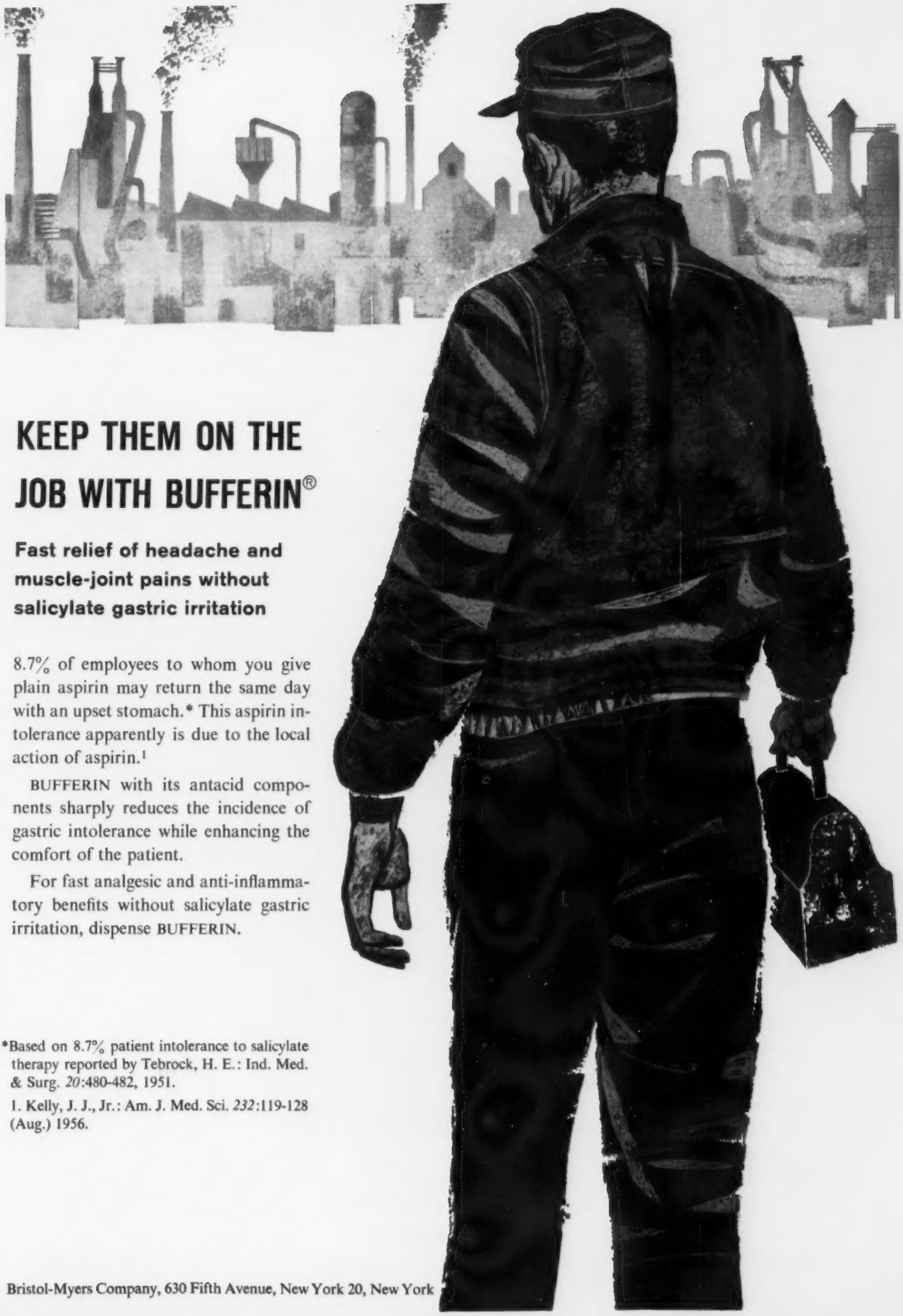

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8.7% of employees to whom you give plain aspirin may return the same day with an upset stomach.* This aspirin intolerance apparently is due to the local action of aspirin.[1]

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*Based on 8.7% patient intolerance to salicylate therapy reported by Tebrock, H. E.: Ind. Med. & Surg. *20*:480-482, 1951.

1. Kelly, J. J., Jr.: Am. J. Med. Sci. *232*:119-128 (Aug.) 1956.

Bristol-Myers Company, 630 Fifth Avenue, New York 20, New York

had stopped the whispering behind the member's back; and she seemed satisfied with this ruse for a time.

Why do these women develop such problems?

At the same forum (sponsored by the Connecticut Mutual Life Insurance Co.), Norman Plummer, M.D., Medical Director of the New York Telephone Co., discussed the differences in absenteeism among men and women. He reported that his company's records showed that absences because of illness were twice as high in women as in men but that men are more likely to suffer life-endangering illnesses. He concluded: "It seems likely that the higher incidence of illness reported by women, the greater amount of disability that they experience and the greater number of visits that they make to the doctor is largely the result of culturally determined differences in their attitude toward what constitutes illness and what creates an acceptable reason for disability."

Are women a weaker sex because they give in more easily to sickness or are they the stronger sex because they take care of themselves and live longer than men?

These examples illustrate the broad national problem involved in helping people to keep regularly at their jobs and to get along with each other. The maladjusted employee is a trouble-maker, he changes jobs frequently and he may be accident-prone. Such poor adjustments and unnecessary absenteeism cost industry an estimated three billion dollars a year. Alcoholism alone causes industrial losses estimated at a billion dollars a year.

—*Waterloo* (Ia.) *Courier*, March 24, 1960.

Heads Up

Safety helmets dramatize the importance of accident prevention at Lehigh Portland Cement Co., Allentown, Pa. Each month a safety hat for each department is hung over a sign reading "Accident Free Departments." If a member from any department is injured, his department's hat is moved over a sign reading "Accident Medical Cases"; if the case develops into a lost-time injury, the hat stays there for the remainder of the year.

—*Industrial Relations News*, May 28, 1960.

Mental Bottlenecks

Ten percent of any industrial population has sufficient psychiatric problems to affect work, said Dr. Alan A. MacLean, Psychiatric Consultant for International Business Machines Corp., at the first clinical session of the Kentucky Industrial Medical Association.

Dr. MacLean, reporting on a study of psychiatric problems in eight industrial plants, noted that such a percentage of psychiatric ills would represent a substantial payroll problem for any corporation. However, industry realizes the importance of mental health and is taking steps to improve the mental health of employees.

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1. Kelly, J. J., Jr.: Am. J. Med. Sci. *232*:119-128 (Aug.) 1956.

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The report showed that the majority of the individuals involved were in the older age bracket and had been with the company for some time. Most individuals have family problems that they can cope with until they are confronted with a major job change. Industry today is attempting to become more familiar with the individual employee, and emotional problems are considered before any major job change is made.

—From *Lexington* (Ky.) *Herald*, April 8, 1960.

Soviet Novocaine

Procaine hydrochloride, better known as novocaine, has been one of medicine's scullery maids for over 50 years. The drug has been used by doctors and dentists almost exclusively as a local anesthetic. However, a recent Soviet medical book reports that Russian medical researchers are now using the old painkiller as an effective treatment for many of the stress diseases.

Cases of peptic ulcer dating back to the seige of Leningrad responded to a series of infusions of procaine into the arteries, so that the patients were able to resume their normal activities, according to the author, Dr. N. K. Gorbadei. Dr. Gorbadei has reported on 177 cases of peptic ulcer treated at the Leningrad Sanitary-Hygiene Medical Institute.

The English translation, entitled *Intraarterial Infusion of Procaine in Therapeutic Practice*, includes as an appendix a report by I. I. Velikanov on treatment of hypertensive patients with intraarterial procaine infusions. Dr. Velikanov's report was first published in the Bulletin of the Academy of Sciences of the Kazak SSR.

In addition to the treatment of peptic ulcer and hypertension, doctors at the Leningrad medical institute have used these injections successfully in the treatment of bronchial asthma, polyneuritis, angina pectoris, and other stress diseases.

The intensity of Soviet interest in procaine as a therapeutic agent is shown by the list of references to other Soviet publications on the subject. This list indicates that at least 16 other Soviet medical research institutes are conducting experimental or clinical trials of procaine as a therapy in the stress diseases. Dr. Gorbadei reports that the effect of the substance varies with the method of injection and also with the type of nervism of the patient.

Procaine hydrochloride is also the active ingredient in the H_3 injections which the Rumanian doctor, Professor Anna Aslan, claims to be a highly effective therapy for many of the diseases of old age, including arthritis, Parkinsonism, senility.

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1. Kuba, E. F.: First Stage Treatment of Burns and Prevention of Shock, Indust. Med. 12:369-371 (Aug.) 1958.

Send for literature . . .

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inent members of the medical profession were told by Norman Jaspan, management consultant and author of *The Thief in the White Collar*. Mr. Jaspan pointed out that hospital costs could be slashed as much as 20% and patient care cost substantially reduced; he placed the primary blame for this financial plight largely in the laps of members of the boards of trustees.

Many trustees have a full time job of running their individual enterprises, he said, whereas a hospital administrator must run many businesses. This is a huge and complex responsibility . . . the operation of a hospital is not only big business but a combination of many large businesses. "After all," said Jaspan, "a hospital has the same problems as a pharmacy, hotel, laundry, restaurant, purchasing department, research institution, fund raiser, educator, public servant, and most important, it must care for the sick. Yet in most cases the hospital administrator must carry out these duties handicapped by inefficient personnel, poor controls, and limited budgets with a work load demanding his attention around the clock, 365 days a year. This must make it impossible for him to know what is really going on beneath the surface."

A 500 bed hospital, for example, probably employs 1,250 workers, and when patients and visitors are considered, may serve a minimum of 3,000 to 4,000 meals a day. There are very few hotels and restaurants that prepare this many meals, stated Jaspan.

The consultant charged that today's hospital is operating under conditions so loose that pilferage and theft of supplies, equipment, food, drugs, narcotics and other expendable goods intended for patients has become commonplace.

There is an abundance of collusion with vendors, approving duplicate invoices, accepting short-shipments, manipulating inventories, dispensing inferior merchandise and other malpractices, Jaspan asserted. In addition, hospital personnel pass judgment on how much to charge their friends and relatives, and which patients are to be classified as welfare cases. In this atmosphere, respect for discipline and controls vanishes.

Jaspan charged that some manufacturers' representatives (detail men), in order to promote their products, flood the market with free goods which often find their way into unscrupulous hands. Many pharmacists, doctors, interns, and others convert these items, originally tendered only for use as professional samples, into cash or exchanges at drug stores. The same often occurs with partly used drugs returned from the nursing floors, which, for a consideration, are given by dishonest employees to a jobber or retailer, who may resell these drugs to the same hospital at the full retail value.

To illustrate, Jaspan told of a hospital pharmacist who caused the institution a loss of approximately $250,000 by operating his own business on the premises of the hospital

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Dosage: One or two capsules as required. In industrial practice, Murray noted that "because of the complete absence of side effects, it is justifiable to increase the medication to two tablets every four hours."*

Supply: Bottles of 100 and 500 capsules.

*Dr. R. J. Murray, Medical Dept., Sperry Gyroscope Co., in an article published in the New York State Journal of Medicine, August 15, 1953 (Vol. 53, No. 16).

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with merchandise obtained from detail men, as well as with drugs stolen from hospital stock.

In another instance, a County Welfare Commissioner was convicted recently on an illegal drug buying scheme, whereby drugs purchased through the county hospital for $46,000 were made available to three local druggists at a savings to them of $154,000, much of which they kicked back to the County Welfare Commissioner.

The need for stricter controls in hospitals today is desperate, Mr. Jaspan noted—both from a moral viewpoint as well as a sound business objective. In the lax atmosphere which is permitted to exist in hospitals, employees drift from petty pilferage to larceny on a major scale. By failing to control these routine functions, hospital management is not fulfilling its moral responsibility. Jaspan accused hospital management of forfeiting its prerogative to manage because of its failure to know what is going on in the complex labyrinths of the institution.

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National Health Plan

A National Health Plan, developed by the government with the assistance of professional health associations, has been issued by the Office of Civil and Defense Mobilization.

Issued as Annex 18 to the broader National Plan for Civil Defense and Defense Mobilization, the Health Plan outlines the areas of responsibility, organization, functions and programs for health services under national emergency conditions, including a survival and recovery period that would follow any direct attack on the United States.

In issuing the Health Annex, Director of Civil and Defense Mobilization Leo A. Hoegh said that its major premise is the responsibility of individuals and of professional associations in the health field to take an active part in civil defense and defense mobilization planning and training in their communities.

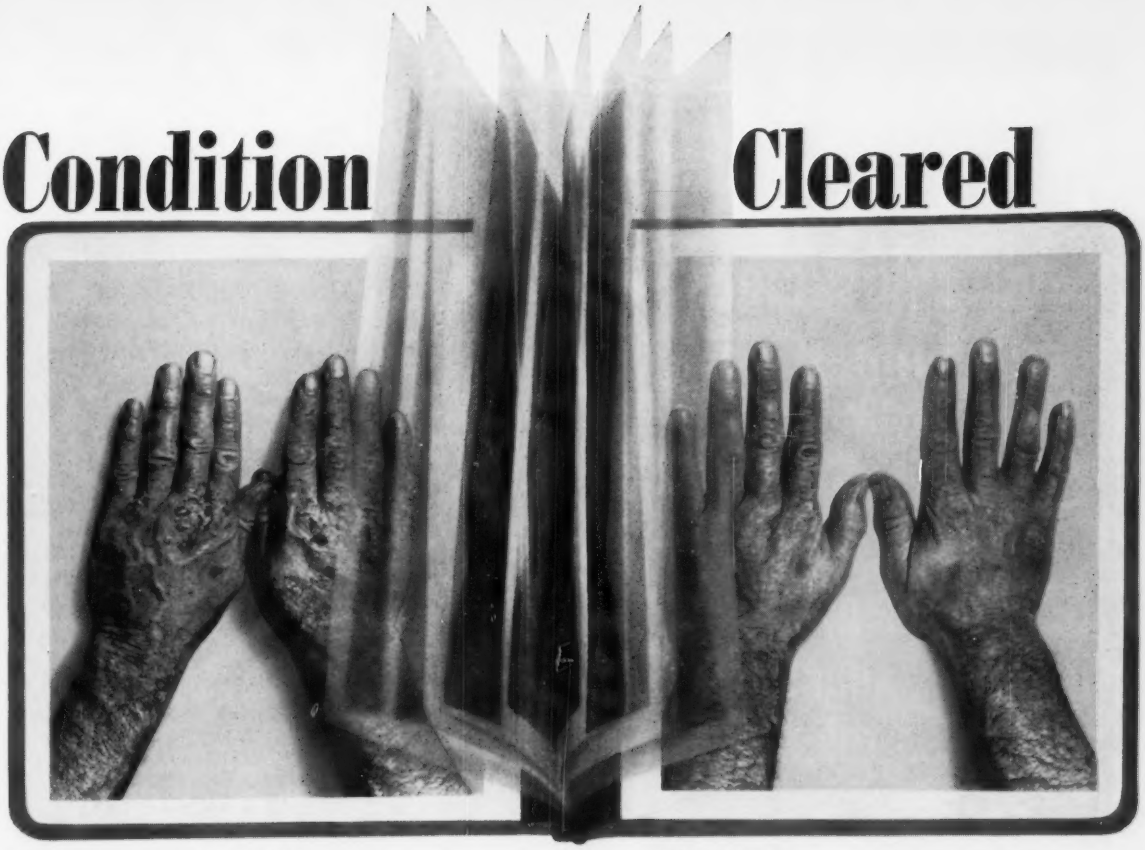
Behind the Plan are the assumptions that a nuclear attack on this country would (1) disrupt organized health services in many communities, and (2) cause severe shortages of health supplies, manpower, and medical facilities.

The basic principle in dealing with these problems is the responsibility of individuals and families to be self-sufficient for a limited period of time after an attack until help reaches them.

Preparedness measures for the family include training in first aid for at least one family member, keeping immunizations current, and the maintenance of supplies of survival items in homes or shelters.

Mr. Hoegh has stressed that the Plan is essentially a guide for State and local authorities as they work out emergency health programs in their areas in cooperation with members of professional health and medical associations, the medical supply industry, business and civic organizations, and other agencies with health interests and responsibilities.

Condition Cleared



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1. Gordon, E. E. and Haas, A.: Industrial Medicine & Surgery 28:217, 1959.

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Index of Advertisers

American Sterilizer Co. 28

Armour Pharmaceutical Co. . . . . 13, 3rd cover

Arnar-Stone Laboratories 31

Bristol-Myers Co. 29

Carbisulphoil Co. 36

Ciba Pharmaceutical Products, Inc. 10

Desitin Chemical Co. . . . 15

Dome Chemicals, Inc. . . . 12

Eaton Laboratories 16

Geriatric Pharmaceutical Corp. 36

Lilly & Co., Eli 24

McNeil Laboratories, Inc. 14

Merck Sharp & Dohme . . 9

Metrox, Inc. 34

Parke, Davis & Co. 5

Riker Laboratories, Inc. 2nd cover

Robins & Co., Inc., A. H. 19, 33

Roerig & Co., J. B. 11

Sanborn Co. 17

Searle & Co., G. D. 25

Shield Laboratories 30

Squibb & Sons, E. R. 22, 23, 35

Upjohn Co. 20, 21

Wallace Laboratories 1, 7, 4th cover

Whitehall Laboratories 18, 26

Williams, Inc., J. B. 32

Winthrop Laboratories . . 2

Woodward Medical Personnel Bureau 27

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1. Billow, B. W., *et al.*: Southwestern Med. *41*:286, (May) 1960.
2. Teitel, L. H., *et al.*: Indust. Med. *29*:150 (April) 1960.
3. Beck, C., *et al.*: Clin. Med. *7*:519 (March) 1960.
4. Clinical Reports to the Medical Dept., Armour Pharmaceutical Co., 1959.

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